

ILLUSTRATIONS
OF THE
NUEVA QUINOLOGIA
OF PAVON.

R. M. Beverley

from his friend

the Author

June 1862. —

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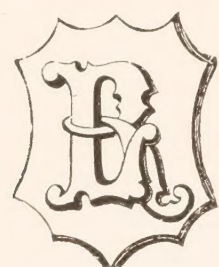
WITH COLOURED PLATES, BY W. FITCH, F.L.S.,

AND

Observations on the Barks described.

BY

JOHN ELIOT HOWARD, F.L.S., ETC.



LONDON:
LOVELL REEVE & CO., 5, HENRIETTA STREET, COVENT GARDEN.
1862.

TO
SIR W. J. HOOKER, K.H., D.C.L. O_{XON.},

LL.D., F.R.S.A. AND L.S.,

Director of the Royal Botanic Gardens of Kew,

IN GRATEFUL REMEMBRANCE OF HIS

COURTEOUS ASSISTANCE

IN THE COURSE OF THE PREPARATION OF THE PRESENT WORK,

This Volume is Dedicated

BY HIS OBLIGED FRIEND,

THE AUTHOR.

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INTRODUCTION.

THE importance of the febrifuge alkaloids to the family of mankind has rendered the plants yielding these medicinal products the objects of unusual study. This is evidenced by the numerous works written on the subject, a catalogue of which, given by Van Bergen, extends over seventy-two pages of his valuable 'Monographie,'* and includes a total of six hundred and thirty-seven publications.

The thirty-four years elapsed since the appearance of that catalogue have presented us with numerous and important additions. Amongst these I shall refer especially to two, on account of the peculiar geographical relations in which they stand to the present work. One of them has illustrated the species of *Cinchona* growing from about the fourteenth degree of south latitude to the extreme southern limit of their range, whilst the other has made us better acquainted with the forms which are found on the Cordillera of the Andes, from the Equator to the most northern termination of the range, where these mountains sink down to the lake of Maracaybo. The present volume exhibits the latest results of the researches of Pavon and his associates, together with a description of some new species presenting themselves in the intervening space of fourteen degrees of latitude. The most northern species mentioned by Pavon is found almost immediately north of the Line; the most southern described in the present work has its habitat near Uchubamba, in regions within two degrees of the rich Calisaya-growing forests of Carabaya and Bolivia. I trust therefore that these three works, taken together, may give, not indeed a complete representation of the whole of the species comprehended in this widely spread genus, but at least an extensive and accurate diagnosis of by far the greater number of its members.

It will readily be understood that I allude in the first place to the magnificent 'Histoire Naturelle des Quinquinas,' published by Dr. Weddell at Paris in 1849, a work unrivalled as regards those regions (Bolivia and Southern Carabaya) which the talented author was able personally to explore. On the other hand, the beautiful work commenced by Dr. Karsten at Berlin, entitled 'Floræ Columbiae Terrarumque adjacentium Specimina Selecta,' furnishes, when read with his other explanatory works, much practically useful and scientifically elaborated information concerning barks before known to us

* Versuch einer Monographie der China. Hamburg, 1826.

only by the fragmentary observations of Mutis. The Pitayo bark alone seems to have had but feeble justice done to it in any of these three works, since the many varieties of this exceedingly important species are scarcely touched upon, although they have furnished of late years a large portion of the supply of bark used in the preparation of Quinine.

The species most strictly called *Peruvian* form the subject of the present work. They were ably investigated by a botanical expedition sent out by the Spanish Government to Peru in 1777, and which lasted eleven years. MM. Ruiz and Pavon were the chiefs of this company of botanists; and after their return to Spain the work of exploration was continued by their disciple and associate, Tafalla. The fruits of this expedition are found in the admirable 'Flora Peruviana et Chilensis,' published at Madrid in the years 1798-1802, also in the 'Quinologia' of Ruiz, Madrid, 1792, and the 'Suplemento á la Quinologia,' by Ruiz and Pavon jointly, in 1801.

In the year 1852, I undertook an examination of the barks collected by Pavon, as found in the British Museum. In this investigation I had the assistance of Dr. Pereira, and the results were given to the public first in the 'Pharmaceutical Journal,' and subsequently in a small work, entitled 'Examination of Pavon's Collection of Peruvian Barks contained in the British Museum' (London, 1853, with an Appendix, under date 1855). I also sent to the 'Pharmaceutical Journal' "Observations on some Additional Specimens of Peruvian Bark presented to the Museum of the Pharmaceutical Society," in 1854; likewise, 'An Examination of Botanic Specimens at Kew,' privately issued in 1855.

I moreover contributed to the 'Pharmaceutical Journal' for October, 1856, a paper "On the Tree producing Red Cinchona Bark."

Still the subject was left in an incomplete, and therefore unsatisfactory state; and I could not help surmising that there must remain at Madrid further results of the labours of the Spanish botanists which might throw light on the many questions still left in obscurity. I consequently caused inquiry to be made, and in the year 1858 obtained by purchase fifty-four specimens of Barks of Pavon's collection, together with an original manuscript in Pavon's handwriting, which appears to have been commenced about the year 1821, and to have been carefully revised and corrected at different intervals by the author. This manuscript was sold shortly before Pavon's death to a botanist in Madrid, from whom it passed into my hands. It is entitled, "A Monograph of Forty-one Species of *Quinas* or Barks belonging" (in Pavon's opinion) "to the Genus *Chinchona*, of which different species eleven are already published in the 'Flora Peruviana,' and the thirty undescribed were discovered in Peru and in various Provinces of Quito by Don H. Ruiz, Don José Pavon, and their disciple Don Juan Tafalla. Finally corrected and enlarged, with numerous interesting observations, by Don José Pavon, Director of the 'Flora.' In the year 1826."*

In order to condense the materials at my disposal, I have omitted Pavon's preface, which did

* Nueva Quinologia, ó sea una Monografia de 41 Especies de Quinas, ó Cascarillas, cuyo Genero en Botánica *Chinchona*; cuyas Especies diferentes, las once estan ya publicadas en la Flora Peruviana y Chilense, y las 30 ineditas descubiertas en el Peru y varias Provincias de Quito. Por Don Hipolito Ruiz, Don José Pavon, y el Discipulo de Botánica Don Juan Tafalla: y ultimamente corregidas y aumentadas con nuevas observaciones interesantes, por Don José Pavon, Director de la Flora. Año de 1826.

I have not found it possible to adhere strictly to the orthography of the word *Chinchona* for which Pavon strongly, and, I think, with justice, pleads, as being derived from the family name of Chinchon.

not appear to me to present any point of peculiar interest, and struck out entirely eleven descriptions not original, added to the forty-one before enumerated. I have also passed over the descriptions of some barks which are not now recognized as belonging to the *Cinchona*.

Pavon's first section comprehends twenty-three species without glands (*sin glandulas*), and twelve with glands (*con glandulas*). They are found in the following order in the Royal Museum at Madrid:—

IN SEPARATE PACKETS. [UNSCROBICULATE.]

- | | |
|---|--|
| 1. <i>Chinchona obtusifolia</i> . | [15. <i>Ch. subcordata</i>] (in Pavon's 'Nueva Quinologia,' but not in the Museum). |
| 2. <i>Ch. lucumæfolia</i> . | 16. <i>Ch. (?) ferruginea</i> . |
| 3. <i>Ch. dichotoma</i> . | 17. <i>Ch. erythrantha</i> . |
| 4. <i>Ch. lanceolata</i> . | 18. <i>Ch. coccinea</i> . |
| 5. <i>Ch. stupea</i> . | 19. <i>Ch. succirubra</i> . |
| 6. <i>Ch. (?) Tarontaron</i> . | 20. <i>Ch. lutea</i> . |
| 7. <i>Ch. (?) Azaharito</i> . | 21. <i>Ch. (?) rosea</i> . |
| 8. <i>Ch. microphylla</i> . | [22. <i>Ch. obovata</i>] (in Pavon's description, but not in the herbarium). |
| 9. <i>Ch. (?) acutifolia</i> . | 23. <i>Ch. (?) viridiflora</i> . |
| 10. <i>Ch. (?) globiflora</i> . | 24. <i>Ch. (?) magnifolia</i> . |
| 11. <i>Ch. hirsuta</i> . | 25. <i>Ch. rugosa</i> . |
| Do. var. | 26. <i>Ch. decurrentifolia</i> . |
| 12. <i>Ch. (?) magniflora</i> . | 27. <i>Ch. palalba</i> .* |
| 13. <i>Ch. ovata</i> . | 28. <i>Ch. macrocalyx</i> . |
| pallenscens (apparently the form <i>Cascarilla crespilla grande</i> , described under the head <i>C. Pahudiana</i>). | 29. <i>Ch. parabolica</i> . |
| 14. <i>Ch. purpurea</i> . | |

IN THE GENERAL HERBARIUM. [SCROBICULATE.]

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|---|--------------------------------|
| 30. <i>Ch. undulata</i> (<i>i. e.</i> <i>glandulifera</i>). | 35. <i>Ch. suberosa</i> . |
| 31. <i>Ch. Chaharguera</i> . | var. |
| var. (<i>colorada del Rey</i> .) | 36. <i>Ch. Palton</i> . |
| var. (<i>amarilla del Rey</i> .) | 37. <i>Ch. heterophylla</i> . |
| var. (<i>crespilla negra</i> ?) | 38. <i>Ch. micrantha</i> . |
| 32. <i>Ch. violacea</i> . | 39. <i>Ch. villosa</i> . |
| 33. <i>Ch. nitida</i> . | 40. <i>Ch. umbellulifera</i> . |
| 34. <i>Ch. Condaminea</i> (<i>i. e.</i> <i>Uritusinga</i>). | 41. <i>Ch. conglomerata</i> . |

Together with three specimens (probably from Mutis) of *C. cordifolia*, *C. oblongifolia*, and *C. ovalifolia*.

Those which I have marked with a (?) are excluded by present arrangements from the genus *Cinchona*. Amongst those retained, the *C. hirsuta* appears, from Pavon's account, to hold a doubtful place, since the capsules open, some from the base towards the apex, others the contrary.

Learning, from correspondence with Don Vincente Cutanda, the curator of the Royal Museum at Madrid, that the original specimens of Pavon existed still in that collection, in the order above enumerated, I dispatched Mr. Fitch, our ablest botanical artist, to secure drawings of these, which, through the courtesy of that gentleman, he was enabled to effect to my entire satisfaction, thus supplying the loss of Pavon's original drawings, which have disappeared.

In addition to various species of *Cinchona* described in the present volume, the *Cinchona Tarontaron* of Pavon was thus sketched for me, from imperfect specimens at Madrid, and also the *Cinchona viridiflora*. I have no doubt that these plants are different from the *Cinchona rosea*,† Pavon (*Lasionema rosea*, Don); I have therefore thought it well to present the reader with Pavon's descriptions

* Always *palalba*, from the Latin *palus*, Spanish *palo*; not *pelalba*, as Karsten and Weddell have it.

† Illustr., p. 5.

without affirming anything as to their proper systematic place. The *C. Tarontaron*, possessing capsules dehiscent from the base towards the apex, approaches nearly (so far as I can judge from the above-mentioned specimens) in other respects also to the genus *Cinchona*.

I have added the description of several which appear to me to be new species, that came before me in investigating the subject. The *Cinchona Pahudiana* is interesting, as having been largely cultivated in Java. The *Cinchona Reicheliana* appears to possess the properties of a good and useful Grey Bark. I cannot find that this new species is at all scrobiculate. In this respect, as well as in its microscopical character, it differs entirely from the *C. micrantha*, to which it is otherwise nearly allied. The *Cinchona Peruviana* I have ventured, from materials placed at my disposal by Mr. Pritchett, to describe as new, the origin of the finest Grey Bark, that which may most truly be called Peruvian. This species had previously been confused by Pœppig with the *C. micrantha*, and by Tafalla apparently with the *C. nitida*.

Amongst the botanical specimens in the British Museum is one labelled *C. rotundifolia*, ined., which appears to be that mentioned by Lambert* as "a very distinct species, being easily distinguished from all its congeners by its narrow cylindrical capsules, and by the narrow linear divisions of its stigma." This species does not appear in the 'Nueva Quinologia;' and though I am disposed to agree with Lambert, I am unable with certainty to separate it from the *C. cordifolia* of Mutis, and therefore leave it undescribed.

My own observations convince me of the general accuracy and fidelity of the descriptions of Ruiz and Pavon, and I have before expressed my concurrence with the judgment of Dr. Lindley,† that "they are entitled to the greatest confidence for care and accuracy," but I should restrict my confidence to their delineation of what fell under their own notice, since nothing can be more incomplete than their information respecting the barks of New Granada; whilst their endeavour to find or to constitute an identity between their own barks and those described by Mutis, has tended much to increase the natural difficulties of the subject.

In the same passage Dr. Lindley expresses his opinion thus: "Nothing can be so absurd as to pronounce the species they have described as mere variations of each other; all they have distinguished are most unquestionably distinct; and the only error that I can discover them to have committed, has been that of having left many other species yet unnamed."

Dr. Karsten appears to have arrived at the same conclusion, since, in a review of the first four Parts of the present work,‡ he says that "we are enabled by means of these works (those of Weddell, of Karsten, and the 'Nueva Quinologia,') to judge of the extraordinary richness in forms exhibited by the family of the *Cinchonæ*;" and that "we see the limits which Weddell recently assigned to the number of species continually more and more extending themselves."

It has been my object to begin in each case *de novo*, and to attain, as far as possible, clear and certain information as to individual forms of the *Cinchonæ* and the barks which are their products, and thus to trace out (following the guidance of authentic specimens) the produce of each sort or variety as it now occurs in the importations from Peru. In order to do this, I have been compelled

* Illustrations, etc., p. 5.

† Med. Botany, p. 409.

‡ Flora, No. 38, 14 Oct., 1860.

to individualize as much as possible, and to disregard many attempts at classification which have been made without sufficient previous knowledge of the facts of the case. For this I have the authority of Schleiden, who gives it as his opinion that “we know next to nothing about the origin of the Loja barks; that we cannot be certain of the identity of the *C. Condaminea* of Weddell with that of Humboldt and Bonpland;” and this very exact and indefatigable botanist comes to this conclusion:—“I shall therefore prefer to retain provisionally the old names of Ruiz and Pavon, namely, *Chahuarguera*, *parabolica*, *lucumæfolia*, *Uritusinga*, *macrocalyx*, and so forth.”

The question of the distinction between species and varieties has been brought forcibly before me in connection with my investigation of this subject. This I entered upon with one set of opinions, which have undergone much modification in the course of my research; and I have thought it the most practically useful to arrange as species all those which are marked by well-defined and, as far as we know, permanent features. It has been successfully shown* that two laws of development pervade all created nature, corresponding in some sense to the faculties of *invention* and of *imitation* which we are continually exercising,—“the law of imitation” continuing the type of each species amidst the continual repetition of individuals composing that species; and “the law of invention,” by virtue of which that which we call nature is more rich and more inexhaustible in realization than our imagination is in conceptions and in ideas of the possible modes of life. Far from following only a straight line in her creations, she creates in every sense; far from having only one model, she is infinite in diversity. So truly indeed is this the case, that we cannot force her to rest in the Procrustean bed of our systems, and constantly find that she throws forth her productions in greater variety and freedom than we can easily follow.

I should therefore be prepared to find in the species of *Cinchona* the same tendency that we trace elsewhere, to diverge into other forms, or to *sport*, as the gardeners call it, and think that well-marked instances may be found in the following pages. Many of the species throw themselves into numerous variations, which are manifestly but different forms of the same plant. In other cases we find connecting links between two separate species in some type which partakes of the nature of each. Thus, in a visit to Paris, when I had the pleasure of reviewing the collection in the Museum of the Jardin des Plantes with Dr. Weddell, I was especially interested by the specimen of a peculiar form of the *C. micrantha*, which he showed me amongst the collections which resulted from his last journey. This specimen Dr. Weddell placed side by side with one of *Calisaya blanca* (which variety also differs much from the normal type of *Calisaya*), and the two were found to approach extremely near to each other. This form appears, consequently, to have equal right to be considered a variety of the *C. Calisaya* or of the *C. micrantha*; and it may eventually be found best to constitute it a distinct species, especially as I believe this form to be the origin of a distinct sort of bark, largely imported from districts adjoining Bolivia. My specimen of this bark, which I had labelled “*Cinchona micrantha?*” was called by M. Guibourt “*Cascarilla blanca*.” It is nearly as rich in Quinine as the *Cinchona Calisaya*, and sells for a proportionately high price in commerce.

It is probable that intermediate forms exist between several of the leading species. “The hard-

* *Vide* Traité Philosophique et Physiologique de l'Hérédité Naturelle. Par le Dr. Lucas. Paris, 1847.

coated variety of the *C. ovata*," which I have described elsewhere as the source of the *Cortex Chinæ pseudo-regius* of Martiny, must, I think, be intermediate between the *C. ovata* and the *C. micrantha*; and *C. ovata*, var. *Cascarilla crespilla grande* (or *C. ovata* of Weddell), is perhaps intermediate between the *C. ovata*, R. and P., and the far more highly cinchonaceous Cinchonas, the *C. ovata*, vars. *rufinervis* and *erythroderma* of Weddell; whilst the *Cascarilla crespilla chica* is apparently a descent in the scale, and finds its place somewhere between the *C. parabolica* and the *C. Carabayensis*. Again, there appears to be an intermediate form, perhaps between *C. ovata* and *C. Calisaya*, which Dr. Weddell described to me as a variety of *C. ovata*, the bark of which is exceedingly rich in Quinine. The *C. Condaminea* passes through various forms into the *C. Pitayensis* in Popayan, and thence perhaps into numerous varieties of the *C. lancifolia*, Mutis, in New Granada, some approximating to those last mentioned, others (to judge from specimens at Kew and Paris) approaching to the *C. nitida* and to the Loja barks, the so-called *Quina primitiva* type. I must however remark, that I cannot trace these in any regular geographical succession; and, what is sufficiently curious, I find the most northerly form of these, the *C. lancifolia*, reproduced, with very slight variation, at the most southerly point to which this alliance of the Condaminea-like species can extend, viz. at Uchubamba, where it is associated in Dr. Hasskarl's collection with the *C. lanceolata* and another form of the same plant, both too widely separated to be classed by Dr. Weddell under *C. Condaminea*.

I have noticed, under the head *C. purpurea*, reasons for believing in the existence of commercially valuable forms of this species, to which I should perhaps add the *Cascarilla naranjada* of the collection of Dr. Hasskarl, the source, as I think, of the sort called "Carabaya Bark" in the English market.

The occurrence of these intermediate forms suggests the inquiry whether all the species of Cinchona have had but one and the same origin, and have varied, by the influence of climate, soil, etc., into the many sorts which we now behold. Some circumstances, such, for instance, as the occurrence of a form of *C. lutea* in a region intermediate, and itself occupying a sort of intermediate place between that species and the *C. cordifolia*, render this theory a plausible and captivating one. The microscopical structure of the *C. lutea*, var. *Ynta*, appears to me to be almost identical with that of the *C. cordifolia*, Mutis, whilst that of the *C. lutea*, var. *Chito*, verges closely on the *C. pubescens*, as may be seen by comparing Weddell's section of this latter bark. Indeed, the various species and varieties and subvarieties of the Cinchonæ form a continuous series, passing by degrees from those which form the central points of the group to those which lie on the very outskirts, and almost insensibly intermingle with the kindred genera, so that there is no more sharp division between these outlying Cinchonæ and the cinchonaceous *Ladenbergiæ* than between those and the proximate species of their own genus.

The interweaving of characteristic features is thus not confined to the genus under consideration; whilst these allied genera again, by their affinities with the lower members of this family, render the line of partition doubtful, as I have had occasion to remark in the course of this work in reference to the *Cinchona ovata* and the *Cinchona magnifolia* of Pavon; the former fully recognized as a true Cinchona, the latter, although closely allied, excluded from the family.

Moreover the same interconnection is found to pervade all nature, furnishing an evidence of the

oneness of conception in the all-creating and all-pervading Infinite Mind, in whose works we everywhere trace unity of design and permanency of type, conjoined with the greatest possible variety in the mode of developing these types in the infinite diversity of the individual creatures. The *one* and the *manifold* seem everywhere to be associated, and even blended together; so that as soon as we attempt to grasp and individualize *the one*, we find it expand under our hands into the many-sided and variously-related *manifold*. We thus find it difficult absolutely to isolate any part of creation; and when, on the other hand, we resolve to look upon the *many*, we are constrained, by connection of type and structure, to revert back to some one common type of the whole, so wondrously the infinitely diversified harmonies of the creation are blended into one hymn of praise to the infinitely varied Wisdom which has planned, built, and still upholds the whole.

Whatever may have been the history of the *past*, there can be no question of the absolute permanence of all the forms of *Cinchonæ* which meet our view in the well-balanced *present*. It is interesting to observe the exact way in which every minute feature of the barks gathered by Pavon nearly a century since, are reproduced in those now brought from the same districts. Thus, also, specimens of Loja bark given me by Mastenbroek as from the collection of Sir J. C. Brandt, and reaching as far back as 1722, exactly represent the *C. Uritusinga* and *Cascarilla amarilla del Rey* of the present, even to the characteristic white crystal cells dotting the internal surface; and so in every case that I have yet met with.

It seems to me consequently that every form, in this sense permanent, which can be looked upon as distinguished by well-marked characteristics from every other, is best treated as a distinct species rather than as a variety; since in describing nature we have to record that which is actually before us, without being compelled to rest our classification on hypothetical conjectures as to the past.

I have no doubt that the principle of natural selection, as illustrated by Darwin, fills up a most important part in the general economy of the world, but am very far from thinking that it will bear the stress attempted to be laid upon it, and I do not see that it throws more than a feeble light on the prevalence of species in particular localities, as it seems to me that the result must have been very different if all the *Cinchonæ*, for instance, had been derived from a single species, and allowed to develop differences which by degrees usurped the situations most favourable to them. I cannot but conclude that the variety would have been much less marked, and that we should scarcely have found the most dissimilar sorts growing side by side, as appears now to be the case, and as will be found recorded, for instance, in the reports of different journeys to obtain plants of the Calisaya for transplantation to India.

In considering the question as to which of the species of *Cinchonæ* is most truly and characteristically representative of the genus, I have found several candidates of almost equal merit, and do not know how to assign the place to any one as being pre-eminently its central point. The *Cinchona* of Loja has by some been regarded as the type of the genus, and consequently Loja has been taken geographically as a centre of distribution; but it certainly appears that this preference depends upon the casual fact of our acquaintance with the species having commenced in that region, rather than upon any real superiority. Weddell, starting from the more southern species, makes the *C. Pitayensis* a

variety of the *Cinchona Condaminea*; whilst Karsten, commencing with the Mutisian species of the north, is inclined to look upon the Pitayo sort as a variety of the *C. lancifolia*. Both these modes of considering the subject appear to me to be purely arbitrary; and I cannot but suppose that if the barks of Pitayo had been the first known, they would always have borne away the palm on account of their more copious yield of alkaloids, as also from the much greater abundance of these trees in the forests of Popayan than in those of Loja.

The Bolivian species of Calisaya, including the *C. Boliviana* and the *Calisaya morada fina* (which last appears to me to be not yet described), are beyond all question those which are most esteemed in commerce, on account of their greater proportionate product of Quinine, but it is by no means certain that they contain the largest percentage of alkaloid. This maximum is perhaps attained by some specimens of the Red Bark of commerce or of the Pitaya bark of Popayan; and it must be understood that certain varieties, that of the *C. lancifolia* for instance, which is called *Calisaya of Santa Fé*, and that of the Pitaya bark, which is well known to the dealers, rival, in their rich product of Quinine, the barks of Bolivia, and consequently command a very high price. The Red Bark obtains, from circumstances, much the highest price in the market; and I should be disposed to reckon it pre-eminent, were it not for the large, downy, unscrobiculate, and almost *Ladenbergia*-like leaves, which speak of its habitat being in a warmer climate than that which suits most of the species of the *Cinchona*, and tend to assimilate it, through the *C. ovata*, with the sweet-scented but worthless *Ladenbergia*. In point of production of the most strikingly cinchonaceous substance next to the alkaloids, that of Cinchona-red, it greatly excels all other species. The microscopical structure, such as it is found represented in my second microscopical Plate, is interesting, as giving the characteristic features of the valuable *Cinchonæ* in the highest degree.

The period during which I have been occupied in the present work has proved favourable in many respects to its successful completion. Even as early as the year 1737, M. La Condamine was alive to the importance of introducing the Bark-tree of Loja into other regions of the world, and succeeded in bringing with him on his return to Europe some plants from Yangana, which were unfortunately swept overboard, after having been carefully preserved during a voyage of 1200 leagues, by a large wave which struck the vessel in which he was embarked, near the mouth of the river Amazon. Since that time the increasing conviction that it is necessary to guard against the possible failure of the supply of Quinine-producing barks from South America, owing to the extravagance with which these have been cut down and destroyed without any pains being taken for their replacement, and the hopelessness of seeing any change for the better in the management of their native forests, has induced, first the Dutch Government, and then the Anglo-Indian Board of Direction, to take steps for the transplantation of the *Cinchonæ* to suited regions in the East. This has necessarily led to the accumulation of many facts which tend to elucidate the genus. In 1852, the Minister for the Colonies of Holland proposed to the king that a proper person should be sent to South America to collect seeds and plants and to transport them to Java. This mission was confided to Mr. Justus Charles Hasskarl, previously botanist of the Botanical Gardens at Buitenzorg, Java. M. Hasskarl proceeded from Lima, across the Cordilleras by Vitoc to Monobamba and Uchubamba, returning from Monobamba

across the second Cordillera to the capital of the province of Jauja. He then pursued a southerly course to Cuzco, and thence to Sandia, in the rich Calisaya-producing district of Carabaya, near to the frontiers of Bolivia, which he was not permitted to enter. Having received at Sandia a considerable number of Calisaya plants, he proceeded with them to the coast, accomplishing a journey of a hundred and fifty leagues, and bringing his precious burden in safety across the snowy mountains, having to guard it, not only from the strong drying winds and the almost perpendicular rays of the sun, but from the low temperature at night. The plants were closely packed, together with the roots, in damp moss; each packet was wrapped in the bark of Pisang stalks, fastened with sackcloth, and made into small bales somewhat resembling wool-bales, as those in which goods are forwarded on the llamas from the interior to the coast. The Pisang stalks had to be fetched from the lowlands, and the moss from the mountain districts. Arriving thus at the port of Arequipa, and thence embarking for Islay, he succeeded in placing the plants in Wardian cases on board a frigate which the Dutch Government, with wise forethought, had placed at the disposal of this important mission, and ultimately arrived at Batavia on the 13th December, 1854, with twenty cases of plants, from which the propagation of the species in Java has been successfully accomplished, as the reader will find under the head *Cinchona Pahudiana*. This latter species was raised from seeds sent by Mr. Hasskarl, and, together with several other apparently new forms, was the result of the exploratory journey which I have thus succinctly traced through districts whose botanical treasures had not been made known by any previous traveller. Amongst these new forms I may mention the *Ichu Calisaya* (differing from the *C. Josephiana* of Weddell), the *Cascarilla naranjada*, the *Cascarilla con Hojas de Durasno*, the *Calisaya morada fina*, a very fine sort of Calisaya, which I have also in quills from Weddell. The latter plant is much nearer to his *C. rufinervis* in the leaves than to the Calisaya; and as this is also represented in Hasskarl's collection, I was enabled to note the leaves of the *morada fina* as a little less broadly ovate and more acuminate than the *C. rufinervis* or the simple *morada*. The above were all from Carabaya; also from Uchubamba, the *Cascarilla baya* seu *amarilla*, apparently *C. lanceolata*, Pavon, *Cascarilla crespilla chica*, for full information on which see under *C. Pahudiana*; *Cascarilla Azahar*, very near to my specimens from Karsten of *Cinchona lancifolia*, Mutis; *Cascarilla crespilla grande*, for which also see under *C. Pahudiana*. These, together with some known and a few other dubious forms, Mr. Hasskarl has courteously allowed me to share; and as Dr. Weddell, in regard to the more southern, and Dr. Karsten as to the northern species, have permitted me the same privilege, I have been greatly helped in such knowledge as the comparison with each other of dried specimens, with their accompanying barks, can afford.*

The late Dr. Royle was the first person to recommend the introduction of the *Cinchona* into India, in his work on Himalayan botany, published in 1839, but nothing was done until, in the year 1852, the subject was again brought to notice in a letter from the Calcutta Government to the Home authorities, dated March 27th, 1852; upon which Dr. Royle drew up a Report, which led to a request being made to the Foreign Office, that the *Cinchona* plants and seeds might be procured through the instrumentality of her Majesty's consuls in South America. This measure, however, led

* Dr. Karsten's barks unfortunately were all lost, and I must therefore except these from the list.

to no useful result. Mr. Cope, the venerable Consul-General of Ecuador, was the only one who transmitted any plants, and they all died on their arrival in England, in December, 1853. Some seeds of the *C. Calisaya*, procured through Mr. Pentland, and six plants contributed by the Kew and Edinburgh Gardens, and which had been raised from Dr. Weddell's plants, were, however, taken to Calcutta by Mr. Fortune, but the seeds never germinated, and the plants all died on their removal to Darjeeling.

Notwithstanding this failure, Dr. Royle, who took the deepest interest in the subject, drew up another Report in May, 1853; and in March, 1856, he proposed that Dr. Jamieson of Quito should be commissioned to collect plants of *Cinchona* in the province of Ecuador.

In the year 1859, Clements R. Markham, Esq., was selected to carry into execution the plan thus previously traced out for the introduction of the Bark trees into India, and on March 22, 1860,* he left Arequipa, accompanied by a gardener, and after a painful journey, in the course of which he had to surmount snowy heights 15,500 feet above the level of the sea, reached the scene of his researches on the eve of hostilities breaking out between Peru and Bolivia. This disadvantageous state of affairs induced Mr. Markham to abandon his intention of entering Bolivia, and to direct his steps to the same portion of Carabaya that had before been trodden by Hasskarl. It was not without surmounting difficulties which would have deterred a less enterprising and energetic traveller, that Mr. Markham succeeded in collecting, from the valleys of Sandia and Tambopata and the banks of the Yana-Mayu, a number of young plants of the Calisaya, chiefly from the small ravines and gullies filled with beautiful vegetation, as the *Cinchonæ* appear to dislike situations exposed to the full glare of the sun. Mr. Markham thus describes on one occasion his experience of the difficulty of travelling in these localities:—"On the 4th May I made a toilsome and dangerous forest journey along the most giddy precipices overhanging the river, with no foothold but decaying leaves, nothing to grasp but rotten branches, every motion a drenching bath from the wet branches, every other step a painful and dangerous slip or fall." At a distance of fifteen miles below Sandia he first met with a number of young plants of the Calisaya growing by the side of the road, and older shrubs of the same species lower down the slope, with their exquisite roseate flowers, and rich green leaves with crimson veins. Here the perpendicular cliffs rise up from the river to a stupendous height on either side, and the path winds up in zigzags to creep along the edge of steep grassy slopes or pajonales, far above the tropical vegetation of the ravine. The rock seemed to be a hard schist, much discoloured with red oxide, quartz occurring here and there; the soil a stiff brown loam, with a little vegetable mould. A little above the road there was a small thicket of *Andromeda* and purple *Melastomaceæ*, in a shallow gully, surrounded by the long-bladed grass of the pajonal. Here grew the *Cinchona Carabayensis* and the *Calisaya Josephiana*. The height of this spot above the sea was 5422 feet, and amongst the plants growing round the *Cinchonæ* were *Andromeda* and *Blechnum* and *Trichomanes* Ferns. The scenery of this part of the valley is described as remarkably beautiful. The situation most favourable to the growth of the *Calisayas* appears to have been a ridge of rocks jutting out from the forest-covered sides of the ravine, from 500 to 600 feet above the river Yana-Mayu, not so densely covered

* Letter from C. R. Markham, Esq., to the Under-Secretary of State for India.

with vegetation, where young plants receive shade from taller trees, whilst they also enjoy plenty of sunshine through the spreading branches. Here grows the *Compadre de Calisaya*, the *Gomphosia chlorantha* of Weddell, the bark of which resembles very closely that of the *Cinchona* which it accompanies. A variety of the *Cinchona pubescens*, called "Huiñapu" by the natives, was met with in this locality, and is described in the 'Letter from C. R. Markham to the Under-Secretary of State for India,' from which I extract these remarks. In different parts of the above ridge of rocks 124 young Calisaya plants were collected, all growing out of the moss, which covered the rock to a thickness of from eight inches to a foot, in company with a few beautiful Hymenophyllums and other Ferns. There was scarcely any soil, the roots spreading along the face of the rock, which was a clay slate, easily broken up into thin layers by the growth of the plants. In these situations and in the adjacent localities Mr. Markham succeeded in obtaining 237 plants of *C. Calisaya*, *a vera*; 183 plants of the *C. Boliviana*; 75 of *C. Calisaya*, β *Josephiana*; 2 of *C. Calisaya verde* (a sort not before described, although Dr. Weddell received the bark of it in his second journey, and gave me some specimens); 9 of *C. ovata*; 16 of *C. ovata*, β *rufinervis*; and 7 of *C. micrantha*, *C. affinis* of Weddell. This valuable collection was packed in damp moss; and in order to escape the difficulties which the local authorities interposed to its removal, Mr. Markham resolved to make his way with it directly across the Cordillera to Vilque, and thence to Arequipa. This journey over an uninhabited and frozen tract of country, exposed to furious gales of intensely cold wind, occupied eight days, and occasioned much anxious care to protect the plants, well packed in Russian matting, from the cold at nights, the thermometer sinking on one occasion as low as 16° Fahrenheit. The transit was safely accomplished, however, as well as the remaining journey to Islay, which was reached on the 1st of June. The plants, which were found to be, on the whole, in a favourable state (seventy-three having been killed by the cold, broken, or lost on the journey), were then planted in Wardian cases. I cannot but suppose that if the Government had (after the example of the Dutch) provided a vessel to take them at once to Ceylon, all would have gone well, and Mr. Markham's care and zeal have been fully repaid. The remainder of the history is disappointing, as the long transit by way of England, and especially the perils of the navigation of the Red Sea in the hot season, and further detention at Bombay, so told upon the plants, that on their arrival, the 12th of October, they were found to be in a suffering state; and finally, notwithstanding every care bestowed, they have all perished but two, thus demonstrating the difficulty of the undertaking. The result is the more to be regretted, as some of the species are not likely to be replaced.

In the meantime Mr. Pritchett, who had been charged with carrying out the collection of seeds in the Huanuco district, successfully prosecuted his mission, and obtained an abundant supply from the trees producing the three principal and most valued species of Grey Bark. He left Huanuco for the forest on the 9th June, 1860,* passing over the Cuesta de Carpis *viâ* Acomayo. The great mountain-range of Carpis may be considered the outpost of this part of the forest. On one side, from its towering elevation, you look over the boundless sea of forest vegetation to the eastward; on the other, in the direction of the Cordillera and Huanuco, the prospect consists of every form of bare

* Letter from G. J. Pritchett, Esq., to the Under-Secretary of State for India.

rock and arid mountain, except in those few instances where the bed of a valley is visible, and green patches of irrigation can be distinguished. On the forest side the vapour and cloud which rise are continually bathing the woods, which seem at this spot to be the focus of converging clouds. They are carried over the summit of the range towards the more heated plains of Acomayo, and bear with them in that direction, for a short distance, their beneficial influence. The rapid atmospheric changes which take place at this point are remarkable, every vicissitude of temperature being experienced in a few hours. At one time a raging tempest of rain and wind, at another the calm, tranquil, leaden atmosphere of chilling cloud and fog. It is to be presumed that the almost fathomless depths of the water-worn abysses of the forest, and the great proximity of their sides to each other, at the same time that they are under the influence of a tropical sun, will account for these phenomena.

These regions are the favourite *habitat* of many species of Bark. The *Cinchona purpurea* immediately arrests attention, on account of the distinctive character of its foliage: it is very abundant in this locality. The *C. nitida* is common on the north-east side, and at the upper part of the mountain. The *C. micrantha* and *C. Peruviana* are both inhabitants of the lower levels of the mountain. The *C. ovata* and the *C. obovata* are also met with here; but the nature of the ground, the dense and lavish character of the vegetation, which is exuberant beyond expression, have hitherto effectually kept this region in a perfect state of seclusion, and almost entirely unknown, except to the few natives who have been urged by hunger to thread their way in naked loneliness through the brakes and sloughs of its rank wastes when escaping from some oppressive estate-owner, or whilst pursuing the chase of some wild animal, for food to support the exertion necessary for threading the difficult mazes of the entangled woods.

Chinchao is the first village met with in descending the valley of the river of Casapi, of which Carpis is the head. It gives its name to a Cinchona district which extends along the valley, and also connects the crest of Carpis with the important bark-mountain of Cayumba, within a league or two of the river Huallaga, to which the river of Huanuco is tributary. On this chain of hills the same species of Cinchona are met with: in the upper parts the *C. nitida* and *C. obovata*; in the lower the *C. purpurea* and *C. micrantha*.

Casapi is situated at the lower or eastern end of the above valley, and this was the first scene of Mr. Pritchett's continuous explorations. With the assistance of the son of the gentleman who entertained Dr. Pœppig, he examined the adjoining woods, and found that, with but rare exceptions, every Cinchona-tree had been felled, and nothing was left to subsequent collectors but to wait till the younger plants should come to maturity.

The high land formed by the junction, at an acute angle, of the Casapi valley with that of the Huallaga, is called Casapillo. Its height above the woods of Casapi is 400 or 500 feet. The one species found here was *C. nitida*, the only habitat of which is in airy situations; but, as in the case of Casapi, it had been visited by the collectors, and every bark-tree had been felled. It was soon abandoned for other places of better promise.

The chief of these was the mountain called Cocheros, at about three leagues from Casapi, close to the Huallaga. The owner of these haciendas told Mr. Pritchett that the spot had never been

visited by collectors, and that Mr. P. could prosecute his search in its woods as much as he pleased. It rises, an isolated mountain, from the low land at the confluence of the two rivers, to a height of about 1200 feet above them. This point is about the centre of the bark-district of Huanuco, and it was decided to make the entire collection of seeds and plants from this spot.

The first examination of Cocheros was not encouraging. Mr. Pritchett commenced on the eastern side of the mountain, and ascended along the south-eastern face in a zigzag direction until the summit was reached. Here an abundance of the *C. nitida* trees was met with, having a fair quantity of seed, though in the early part of the ascent he was greatly disappointed at meeting with only few, but very fine specimens, of the *C. nitida* and *C. micrantha*. Mr. Pritchett comforted himself, however, with the reflection, that it was probable the sunny side of the mountain would prove more favourable to the Cinchonas, more particularly to those requiring warmth and moisture; nor were his expectations disappointed when on the next day his course was directed due north, and continued along this face of the mountain in a horizontal direction, where a most satisfactory assemblage of trees of *C. micrantha* was met with. The *Cinchona Peruviana* was comparatively scarce as compared with the *C. micrantha*. They both grow to a very large size, and the foliage is somewhat similar, but they are easily distinguished by the bark. Some of these 'Grey Bark' trees were found to be as large as thirty inches in diameter, and rising in some instances as high as seventy feet, had a noble and elegant appearance among their brethren of the forest.

Towards the latter end of July the sun began to make impression on the solid banks of clouds that filled the valleys, and the operation of felling the trees, for the purpose of collecting and drying the seeds, could be advantageously proceeded with. During a fortnight of fine weather seven large trees were felled daily, and their produce in seed was carefully put up in outside wrappings of tarred cloth, every precaution being taken to protect them from external influence. The small plants had been brought in and packed in bundles between layers of the cryptogamous parasites of the Coca-shrub, overlaid with coverings of palm branches bound tightly together, and then enveloped in several thicknesses of the woollen fabric of the country, called "xerga." The plants were, however, so much injured in the transit to India, that when they reached Bombay they were in a hopeless condition. The seeds were forwarded to the Government gardens at Ootacamund, and at once sown; and I am informed by Mr. Markham that, according to a late Report (September 9th, 1861), there were living 890 plants of *C. nitida* and 905 of *C. micrantha*, raised from these seeds, also 42 of the *Cinchona Peruviana*, and 298 of a species without name, thus forming a total, with 6 *Calisaya* and 2361 *C. succirubra*, of in all 4502 young bark-trees in different stages of development. These seeds are now also vegetating in great numbers both at the Royal Gardens at Kew and in Jamaica and in Ceylon, so that the naturalization of the three principal and most valued species of "Grey Bark," *C. nitida*, *C. micrantha*, and *C. Peruviana*, in various localities, is tolerably certain, but, from their unfitness for the production of Quinine, comparatively small good will be likely to result.

More important results will probably attend the introduction of the *Cinchona succirubra*, or Red Bark, into the same quarters, through the exertions of Mr. Spruce. I have referred, under the description of the above species, to the first visit of this traveller to Cinchona-woods in the region of

Alausi. Subsequently, at the commencement of the year 1860, Mr. Spruce* decided that the neighbourhood of Guaranda, as yielding bark of a superior quality, was the most deserving of his attention. These forests cover an area of perhaps two thousand square miles; and for a small payment Mr. Spruce obtained permission to collect as many seeds and young plants as he should require. Mr. Spruce found the finest trees on a stratum of yellow or reddish marl, of immense thickness, and in which few or no stones are intermixed. There was, however, a thick layer of vegetable mould over this stratum, in which the plants grew, as I learn from the statement of Mr. Cross, the gardener who accompanied Mr. Spruce, and by his experience and assiduous care contributed most materially to the success of the expedition. The temperature of the earth in the forest of Limon, on the western slope of Chimborazo, and in the district of Guaranda, was $68\frac{1}{2}^{\circ}$ Fahrenheit, the height above the sea being about 3000 feet. The lowest point Mr. Spruce saw a tree of *C. succirubra* was 2300 feet above the sea, the highest near 5000 feet. It will be seen that the temperature suited to this species is considerably higher than that of many other sorts. "The Red Bark," he says, "grows in comparatively warm moist forests, where palms, large blue butterflies (*Morphos*), and venomous snakes are abundant. When Pavon went to San Antonio and gathered his *Cinchona succirubra*, 'in locis frigidis,' he must have gone thither, not from the Sierra, but from Guayaquil. It is singular that every one who makes that journey suffers from the cold. The traveller soon discovers that his sensations of heat and cold are by no means in proportion to the indications of his thermometer." From these forests Mr. Spruce obtained a sufficient supply of seeds and of young plants, together with a considerable number of cuttings, which struck root, but not without requiring a large amount of careful attention. In gathering the capsules at San Antonio, he profited by his previous observation at Limon, that the seeds rarely fell out for two or three days after the capsules burst, and that the latter closed up again with the dews of night. So by gathering the capsules at daybreak not a seed fell out, nor was there any need for the somewhat extravagant expedient of cutting down the trees to obtain the seed, as the capsules were easily gathered by the natives. The seeds have produced beautiful seedling plants, which may now be seen at Kew; and in addition, six hundred young trees, packed in Wardian cases, were dispatched by way of Guayaquil, of which number I learn that 463 plants safely reached their destination at Ootacamund, in the Neilgherry hills, in India, and that all these are growing and doing well in the Government Gardens. I saw these in their course of transit through this country, and was pleased to observe their generally vigorous appearance.

In addition to this satisfactory introduction of the *Cinchona succirubra*, Mr. Spruce has also added to our knowledge by sending the seeds of an undescribed species (of *Cinchona*?), called *Cuchicara* by the natives, producing, as it appears, a spurious description of Red Bark.

Mr. Markham reports, that he thinks he shall be able to procure a supply of seeds of the *Cinchona Calisaya* from South America, and that the Dutch Government in Java has promised fifty to a hundred plants of *C. Calisaya*, and that Dr. Anderson has been sent to Java to receive them. This gentleman also informs me that there are now four *Calisaya* plants doing well in the Neilgherry hills, three in Ceylon, and thirty or forty at Kew, originally derived from seed brought by Dr. Weddell:

* Report on Expedition to procure seeds and plants of *C. succirubra*, etc., October 12th, 1860.

several of these will soon be transmitted to India. I expect to find an opportunity of contributing the *Cinchona Uritusinga*, which I received from the mountain of that name through the kindness of Don F. T. Riofrio; and moreover I understand that Mr. Spruce has engaged to procure a supply of seeds of the barks of Popayan and Pasto for India, so that there is every reason to hope that nearly all the principal species of this invaluable genus will soon be naturalized, and find a permanent settlement in the regions of the East, even if they should be extirpated in their native forests.

The conditions most favourable for the production of Quinine in the bark of Cinchona plants are well summed up by Mr. Markham as those of continuous vegetation, with a mean temperature of from 60° to 70° Fahrenheit, varying according to the species, an almost constant supply of moisture, and an elevation of from 5000 to 8000 feet, the Red Bark tree descending to a lower level. Mr. Spruce considers that I have been misled by M. Villavicencio in recommending a climate like that of Riobamba for the experiment, as a much warmer atmosphere is desirable for this sort. The site most approved for trial of the *C. succirubra* is close to the travellers' bungalow at Nediwuttum, on the northern side of the Neilgherry hills. The forest, it seems, covers a declivitous slope, at an elevation of about 5000 feet, and extends to the verge of the steep descent to the table-land of Wynaad. There is a good supply of water in the district; the soil is rich, producing, amongst other kindred plants, the *Cinchona excelsa* of Roxburgh (now *Hymenodictyon excelsum*). This jungle is within the narrow limits of the region which receives both monsoons, and moss in great quantities was hanging from the branches and trunks of the trees,—a sure sign of great moisture.

This last circumstance is of great importance, since Karsten* believed that the air arising from the hot dry valleys of the Patia and of the Guavo rendered the bark-trees in the neighbouring forest unproductive of Quinine: he also found that the same tree will produce very differently according to the exposure. Three specimens, he says, were taken from the forest of Tablon, from one and the same mountain-ridge but different declivities, of which one gave only Cinchonine, but 1½ per cent. of this, the second no alkaloid, and the third a very little quinine. All the barks were taken from the lower part of the stem, and not from single trees, but from every tree of a determined portion of the forest to be investigated one or two pieces, so that each analysis gave the medium contents in alkaloids of the trees in the district in question. From this it follows that the variation in alkaloidal contents does not altogether depend on the individual peculiarities of the plants, but that the soil or the influences of the climate (on which the nourishment of the plant depends) call these into existence.

The investigation of the barks of *C. lancifolia* from Choachi, near Bogotá, communicated to Dr. Karsten by Dr. Santa Maria, gave a similar result. The peculiarities of the soil did not permit of any differences being observed in all these cases. It could apparently only arise from the local currents of air which stream down from the tops of the mountains, and from the exposure to the sun and the prevailing direction of the currents of wind, which are quite different on the opposite sides of the mountain-ridge, and on the summit different again.

A good supply of seeds of various species has been forwarded to Ceylon, and these have germi-

* Karsten, Die Medicinischen Chinarinden Neu-Granada's (Berlin, 1858), pp. 17, 18, 19.

nated in great abundance, so that the trial of the climate of the hill country of that island, which seems very promising for the purpose, will also be fully made.

It is quite to be anticipated that the (at present) very hopeful introduction of the bark-trees into India should have yet to encounter some difficulties, as has been the case in Java. To obviate these, and to promote unity and arrangement in the workings of the scheme, will require much perseverance on the part of those engaged in carrying out this laudable design; and it is to be hoped that the Indian Government will not be backward to continue the necessary support. The efforts of such persons should be directed towards obtaining and acclimatizing all the valuable species, and then the multiplication of plants of these *ad infinitum* in the Government Gardens. Afterwards, efforts should be made to induce the natives to grow bark in the same way as they now grow other crops for exportation.

To the venerable botanist Sir W. J. Hooker, I have expressed my obligation, by dedicating to him the present work; but I must not omit also, in concluding this Introduction, to mention the courteous assistance rendered me by Dr. Hooker in connection with my investigations in the extraordinarily rich herbarium of his father at Kew. To George Bentham, Esq., F.L.S., I am indebted for the privilege of inspecting his specimens of *Cinchonæ*, and to John J. Bennett, Esq., F.L.S., for his aid in examining the stores of the British Museum; to Dr. Berthold Seemann, F.L.S., in a very special manner, for judicious and elaborate criticism of portions of the present volume whilst passing through the press; and to various scientific gentlemen on the Continent, especially to Dr. Weddell, Professors Guibourt and Schleiden, and to Dr. Karsten, Dr. Junghuhn, Dr. de Vrij, Dr. W. H. de Vriese, Don Francesco T. Riofrio, and others mentioned in this work, I would here record my grateful remembrance for much assistance afforded in various ways in the prosecution of a task in itself pleasant, and rendered more so by their co-operation, and which will, I hope, not be without fruit in extending the knowledge of the family of the *Cinchonæ*, and promoting the introduction of these plants into new regions of the earth.

J. E. HOWARD.

Tottenham, October, 1861.



W. P. A. del. et lith.

1. CINCHONA CHAHARGUERA Pavon var^s α & β.

1. Cascarilla colorada. del. Rey. N. 549. L. 711.

2. Cascarilla amarilla. del. Rey. N. 550. L. 712

Select crown bark.

W. P. A. imp.

CHINCHONA CHAHUARGUERA.

CHINCHONA CHAHUARGUERA, foliis oppositis, petiolatis, lanceolatis, oblongis ovato-lanceolatisque, undulatis, acuminatis acutisque, pedunculis paniculatis.

Arbor 3-4-orgyalis, comâ frondosâ ramosissimâ. *Truncus* solitarius, erectus, cortice fusco aspero maculis cinereis indutus, rimis longitudinalibus transversalibusque. *Lignum* compactum, durum. *Rami* erecti, teretes, cortice extus nigrescente, intus pallido-cinnamomeo; *ramuli* subteretes, asperi, rimacei, colore ferrugineo-roseo. *Folia* opposita, petiolata, lanceolata, oblonga ovato-lanceolataque, acuminata acutaque, utrinque glabra, subtus nervosa, venosa, integerrima, undulata, marginibus revolutis, glandulis subtus concavis rotundis villosis, ad sinus nervorum ortum insertis, supra prominentibus. *Foliola* floralia opposita, petiolata, parva, ovata ovaliaque, glabra, marginibus revolutis, nervis centralibus purpureis. *Petiole* teretes, purpurei. *Stipulae* duæ oppositæ, supra-axillares, sessiles, ovatæ, integerrimæ, acuminatæ, basi cohærentes, nervo centrali prominente, marginibus revolutis, deciduæ. *Pedunculi* communes, terminales axillaresque, subtetragoni, partiales pubescentes, bracteolis oppositis subulatis ad pedicellorum basim, pedicellis pubescentibus. *Pedicelli* bracteolis subulatis, solitariis ad basim. *Calyx* rosaceus. *Corolla* dilute purpurea, extus pubescens, laciniis reflexis supra villosa-tomentosis, villis albicantibus. *Antheræ* fauce parum exsertæ. *Capsula* ovalis oblongaque, purpurea (nonnullæ capsulæ ventricosæ), bilocularis, bivalvis, valvulis basi dehiscentibus.—*Habitat* in collibus Santa Rosa nominatis, situ Huancocolla appellata, ditone Vilcobamba (*i. e.* Huilcopampa) Loxa provinciâ. *Floret* Maio, Junio, Julio, et Augusto. *Vernacule*, *Cascarilla Chahuarguera*.—*Obs.* 1. Nonnullæ capsulæ monstrosæ apparent ob insectorum punctionem. *Obs.* 2. Cortex amarissimus, gratus, aromaticus, acidulus, in febribus intermittentibus propinatur, et in commercio magno usu fit.—*Pavon*, *Nueva Quinologia ined. sub Sp.* 31.

Varietas prima.* *Cascarilla amarilla fina del Rey*, Pavon (Nueva Quinolog. inedit. sub Sp. 31).—*C. Condaminea*, H. et B. *var. γ*, Lambert, *ex parte*, foliis ovatis utrinque acutis, floribus majoribus!, Lambert (Illus. Gen. Cinch. p. 3).—*C. lutea*, foliis lanceolatis glandulosis obscure virescentibus, petiolo nervoque centrali sanguineis, flore rubro!, Laubert à Pavon (Bull. de Pharmacie, 1810, p. 293).—*C. (innominata)*, *Casc. amarilla fina del Rey*, Ruiz (MS. Compendio Histórico-Médico de las Quinas, Mus. Brit.).

Varietas [secunda?]. *Cascarilla colorada fina del Rey*, Pavon (Nu. Quin. ined. sub Sp. 31).—*C. Condaminea*, H. et B. *var. γ*, foliis ovatis utrinque acutis, floribus majoribus: Lambert, *ex parte* (Illus. Gen. Cinch. p. 3).—*C. colorata*, foliis lanceolatis glandulosis, petiolo nervoque centrali sanguineis, flore rubescente!, Laubert (Bull. de Ph. 1810, p. 294).—*C. (innominata) Casc. col. del Rey*, Ruiz (MSS. M. B.). (TAB. NOSTR. I.)

Varietas [tertia?]. *Cascarilla crespilla negra, parecida á la amarilla fina ó buena del Rey*, Pavon (Nueva Quin. ined. sub Sp. 31).—*Chincona crispa*, *Quina carrasqueña*, *Cascarilla crespilla buena!*, Tafalla (Compendio Histórico-Médico de las Quinas, por Don H. Ruiz, Mus. Brit.). (TAB. NOSTR. II.)

The *C. Chahuarguera* of Pavon is the form of *C. Condaminea* of Humboldt and Bonpland which is represented in the unshaded branch with capsules in Plate X. of the 'Plantes Equinoctiales' of

* "*C. Chahuarguera*, varietas prima, *Cascarilla amarilla fina del Rey*.

"Las cortezas de esta variedad vienen mezcladas con la (secunda) variedad de la Cascarilla llamada *Cascarilla colorada fina del Rey*, que todos los años se extrahian las cortezas para la Real Botica; de cuyas dos variedades se hace un gran uso en el comercio por sus virtudes sobresalientes.

"La *Cascarilla amarilla fina del Rey* y la *Cascarilla colorada fina del Rey* se crian con mucha abundancia en los mismos montes entremezcladas en los Cerros de Uritusinha (ó Pico del Loro, en Castellano), Cajanuma, Boqueron, Latuna, Chihuanho, San Miguel, Santa Rosa, Yamore, y otros varios sitios de la Provincia de Loja. Estas dos Cascarillas, *amarilla* y *colorada*, se obtienen en los *Pajonales* (así llamadas) de los Cerros, y en las Quebradas ó Cañadas, entre arbustos y plantas pequeñas, entre las rocas y tierras sueltas y arénicas, y florecen en los mismos meses que la Cascarilla Chahuarguera, y aun se suelen hallar floridos algunos arbolitos de estas dos Cascarillas todo el año.

"La *Cascarilla crespilla negra, parecida á la amarilla fina ó buena del Rey*, es la misma especie que la *Chahuarguera, amarilla*, y *colorada*, y las variaciones de las tres Cascarillas son de poco momento que no merecen observaciones, pues coinciden todas tres en todos los caracteres específicos de ser una misma especie."—MS. Nueva Quin. Pavon, l.c.

those celebrated authors. It is, according to De Candolle, a distinct variety, mentioned in his 'Prodromus' (iv. 352) as "*C. Condaminea*, β . *Chahuarguera*, foliis ellipticis. *C. Chahuarguera*, Pavon, Quinol. ined., folia specimin. fructif. in icon. Humb. huc pertinent. Varietas distincta, foliis paulo latioribus et calycis lobis paulo longioribus acutioribus."

The origin of the word *Chahuarguera** is to be found in the Quichua language, and appears to be derived from some imagined resemblance in the bark of the tree to garments or ropes made from the fibre of the American Aloe. The *Chahuarguera* is remarkable on this account, that (according to Don Hipolito Ruiz, in an unpublished MS.† in the British Museum) the natives of Loja (Loxa), who are employed in the collection of bark, say that it is known by tradition that it was this kind of Peruvian Bark which was sent by Don Francisco Lopez Canizares, in 1638, to the Viceroy of Peru, the Count of Chinchon, and that its being introduced into commerce led to the discovery of the other sorts.‡

It is therefore truly the *Quina primitiva*, and the Indians appear to have possessed the first knowledge of its uses. Pavon§ attributes to one of them, about the year 1636, the good service of pointing out these to the Corregidor, who asked the Indian for the bark, and also how to use it. At his request the Indian made a tincture, which the Corregidor took, and in a few days the accesses of fever were cut short, and he obtained a speedy recovery of his broken health. The same Corregidor transmitted it to the Countess of Chinchon; and as this circumstance gave rise to the name of the genus, Pavon argues strongly, and apparently not without reason, that this ought to be *Chinchona* instead of *Cinchona*. Custom has, however, so far established the latter mode of spelling, that I have adhered to it in my own observations.

The *C. Chahuarguera* is described by Pavon as growing from eighteen to twenty-four feet in height. As such the Loja tree was seen by M. de la Condamine. He says, "In 1640, the Count and Countess of Chinchon having returned to Spain, their physician, Dr. Juan de Vega, who had followed them, and had brought back a quantity of quinquina, sold it at Seville at a hundred reals the pound. It continued to have the same sale and the same reputation until the trees of quinquina not barked having become scarce, the inhabitants of Loja, in their thirst for gain, and having no means of supplying the quantities which Europe demanded, mixed different barks in the quantities exported to the fairs of Panama, in the time of the galleons; which having been found out, the bark of Loja came into such discredit, that people would not give one dollar the pound, whilst formerly four and six dollars had been given

* The spelling of the word is uncertain, being given as Chauharguera by Ruiz, and also found as Chahuarguaz, and Chahuargutra. *Chahuar* (according to Tschudi's Dictionary of the Quichua language) means "tow from the Aloe fibre," called in Spanish *cabuya*; and *huara* (=guera) expresses the "calzones" of the Indians. *Chahuarguaz* is probably equivalent to Chahuarhuasca, meaning a rope of similar material (*soga de cabuya*); Chahuargutra?=chahuar and chuta, "to tie fast with a knot."

† 'Compendio Histórico-Médico-Comercial de las Quinas,' por D. H. Ruiz.

‡ "Los naturales de Loja dedicados á la recoleccion de las Quinas dicen que, por sucesiva tradicion, se sabe allí que la Quina que el Corregidor de aquella Provincia, Don Francisco Lopez Canizares, remitió en 1638 á los Vireyes del Peru, Conde y Condesa de Chinchon, fué la Cascarilla Chahuarguera, y que introducido el uso de esta en el comercio se fuéron descubriendo las demas Cascarillas inferiores y medianas que hay se comercian."—Compendio Histórico-Médico-Comercial de las Quinas, por D. Hipolito Ruiz, MSS.

§ "Del Descubrimiento de la primitiva Quina en Quito se dice, que por los años de 1636, un Indio de la Provincia de Loja notició al Corregidor de esta la virtud de la Quina, á causa de estar padeciendo unas calenturas intermitientes. Dicho Corregidor pidió al Indio las cortezas, preguntándole el modo di usarlas; que hizo una tintura, tomóla y en pocos dias se le cortáron las calenturas y consiguió en breve tiempo restablecer su quebrantada salud. En los años de 1638 llegó á subir el mismo Corregidor que la Vireyna, esposa del Ex^{mo} Señor Don Geronimo Fernandez de Cabrera, Virey del Peru, Conde de Chinchon, padecia tercianas, remitió una porcion de las cortezas de dicha Quina," etc.—Pavon, MSS. Preface.

at Panama, and twelve at Seville." Again, the trees "become very large when they are allowed to attain their growth: there are some larger than the body of a man; the medium ones have eight or nine inches in diameter, but it is rare to find *now* (in 1737) any of this size on the mountain, which has furnished the best quinquina; the trees from whence the first barks were procured, which were very large, have all perished, having been entirely deprived of the bark, which causes the inevitable death of the old trunk."* It appears, then, that from the wasteful cutting of the trees, those of large size had become scarce even in the days of La Condamine, as is now the case with the *C. Calisaya* in the most accessible localities in Bolivia. According to Humboldt, not less than twenty-five thousand trees were destroyed in one year. I have made particular inquiries on this point, and learn from Don Francisco T. Riofrio, of Loja, who has an estate near the mountain of Uritusinga, (which produces the best Loja bark,) that the trees or rather shrubs yielding that which is known in Loja as *Quina fina*, and in England as Crown Bark, "are generally about four feet in height, rising occasionally as high as nine feet." This *Quina fina*, or Crown Bark, is the sort which, according to Riofrio, is prevalent in the neighbourhood of Loja. The question then arises, whether the large trees spoken of by La Condamine were of the same variety with those of the *C. Chahuarguera* of Pavon, and with the modern *Quina fina*. I must refer the reader to the description of the *C. Uritusinga* for reasons which induce me to conclude they were not identical, and that the largest trees were of this latter kind.

The *C. Chahuarguera* is found represented in the "*Rusty Crown Bark*" of commerce, as I shall presently show, and I shall describe that first which is commercially the most important, the *Quina fina*, or fine Crown Bark of Loja.

This is the Varietas [tertia?] above, the "black *crespilla* bark resembling the fine yellow or crown bark of the king," of Pavon; and again, the "*crespilla* bark" of Ruiz,† who (in his unpublished

* Mém. Acad. Royale des Sciences, Paris, 1738.

† Ruiz, in his MS. 'Compendio,' describes this variety thus (under Art. 4):—

"De la *Quina crespilla*, llamada Cascarilla crespilla buena en Loja; Chinchona crispa, Tafalla, MS.

"La *Quina crespilla* es una de las especies mas estimadas en Loja, y en mi opinion una de las mas activas y eficaces en sus virtudes, así lo ha demostrado la experiencia. No faltan sugetos que lo dan preferencia sobre la *amarilla* y *colorada* de Loja.

"Se halla esta especie en los montes de Cuenca, Loja, Riobamba, Jaen de Bracamoros, Chacapoyas, Mayobamba y Cajanuma, donde se recoge y se comercia como *Quina fina de Loja*. Por casualidad se logran copas de esta especie sola; viene por lo comun mezclada con la suerte llamada de Loja, y tambien mezclada con otras Quinas inferiores, que se recogen en las referidas Provincias.

"Algunos denóminan á esta especie *Quina carrasqueña*, por la semejanza en la escabrosidad de las cañas con las cortezas de las Carrascas ó Quexidos, especie de Quercus. ...

"*Diagnosis de la Quina crespilla*.

"*Superficie*, muy áspera por la abundancia de resquebraduras ó grietas transversales poco profundas.

"*Envés*, negrilla-pardo y rara vez manchado de pardusco mas ó ménos obscuro.

"*Color interior*, rubicundo-fulvescente, mas encendido que el de la Canela de Manila.

"*Encañutamiento*; se arrolla perfectamente, dando una vuelta y á veces dos, una margen sobre la otra.

"*Grosor*; los cañutillos son del grueso desde el de una pluma de escribir hasta el de dos pulgadas en circunferencia.

"*Carnosidad*, compacta, desde media hasta casi una linea; son pocas las cañas que vengán mas de una linea de gruesa.

"*Peso*; con respecto á la poca carnosidad de los cañutillos, son bastamente pesadas; pero abulta mucho una arroba de ellas por la arqueadad ó torno que tienen los cañutillos.

"*Consistencia*, resistente y fuerte, sin embargo de la poca carnosidad que tiene las cañas.

"*Quebro*, muy igual sin barbillas, y se tronchan los cañutillos con limpieza, como se fueren de vidrio, causando ruido ó estallido.

"*Zugo gomoso resinoso*, abundante, formando un cerco obscuro hácia la parte exterior de la corteza.

"*Olor*, aromático, notable quando se destapan las cajas ó varijas en que se halla conservada.

"*Sabor*, muy amargo y activo, presentándose luego que se principia á masticar la corteza con cierta acidez y austeridad sensibles."

‘Compendio’) mentions it as being called *Cascarilla crespilla buena* at Loja; *Chinchona crispa*, Tafalla, MSS. The Crespilla, he says, is one of the most esteemed species of Loja bark, and, in his opinion, one of the most active and efficacious in its properties, as experience has demonstrated. There are not wanting persons who give it the preference over the *amarilla* and *colorada* of Loja. Some call this species ‘Quina carrasqueña,’ on account of the resemblance in the roughness of the quills to the bark of the Carrascas, or Quexidos, a species of Oak.* He identifies the *Quina fina de Loja* with this *Quina crespilla* or *Quina carrasqueña*, the *Chinchona crispa* of Tafalla. Of this he gives a minute description, which accords entirely with the characteristic features of the “fine crown bark,” such as it is now sold, and such as Riofrio saw in my collection, and recognized as *Quina fina de Loja*.

The *Quina fina de Loja*, in Pavon’s collection, also appears to be the same with the *Crespilla negra* or *buena*, but the best specimen for identification of this kind is one brought home by Dr. Berthold Seemann, together with the botanical specimens taken from the same branches, which are now preserved in the collection of Sir W. J. Hooker at Kew, of which Dr. Seemann writes me thus: “I gathered my specimens of *Quina fina* on Riofrio’s estate you mention, and Don Mariano Riofrio (the Governor of Loja) pointed it out as *the true Quina fina*. I remember that I stood on the back of my horse when I gathered the flowers, so that the height of the plant was exactly what you say.” Dr. S. also informs me that the elevation of the place of growth did not appear to him greater than the altitude of Loja, which is, according to the ‘Geografia del Ecuador,’ 2,448 varas, or, according to Dr. Seemann, 6,772 feet above the level of the sea. This sort is the “Silver Crown Bark” described by Pereira, and forms a portion of all the best importations from Loja, packed, as is usually the case with bark from Loja, in chests, whilst bark from Cuenca and Jaen, etc., comes in bales or serons. It is judged of in part by the brittleness of its fracture, and it is much valued on account of its appearance, and of the aroma, which is described by Guibourt† as analogous to that of tobacco. A parcel has quite recently been sold at a higher price than that of Calisaya quills. The surface, elegantly marbled with white and yellowish Lichens on a blackish or silvery ground, indicates a place of growth favourable to the production of a fine quality of bark; nevertheless the proportion of alkaloid is not great, owing apparently to the slender size of the quills, some of which could not easily be distinguished from the *C. Calisaya*, var. *Josephiana*, as brought home by Dr. Weddell, and given me by that gentleman.‡ The identity of the adherent lichens increases the resemblance. The *Josephiana*, moreover, bears the same relation to the normal *Calisaya*, both in the diminished size of the quills and their inferior produce in alkaloids, that the *Crespilla* bark at Loja does to the normal and large-grown *Chahuarguera*. It is an interesting inquiry to what extent circumstances may have influenced this change.§ Don T. F.

* The Quexido is, I believe, the *Quercus coccifera*.

† In describing the “Quinquina jaune du Roi d’Espagne.” The barks are similar in this respect, and are often found together.

‡ Ruiz says, in his MS. ‘Compendio,’ “Lo cierto es que ni unos ni otros saben distinguir las Cortezoncillas de la Quina de Loja de las de la Calisaya.”

§ Dr. Weddell says, “J’ai longtemps cru que cette variété (β *Josephiana*) devait constituer une espèce distincte; mais une étude plus approfondie et faite sur les lieux m’a démontré qu’elle n’était qu’une forme particulière du type auquel je l’ai rattachée. J’ai même peu de doutes maintenant que les districts qu’elle occupe n’aient été autrefois couverts de forêts, et que, lorsque celles-ci sont tombées, par l’effet sans doute de l’incendie, la plante n’ait en repoussant pris cette forme rabougrie.” It is easy to believe that the character of the leaves may undergo the changes which Dr. W. describes under such altered circumstances, but it seems to me less easy to conceive that these should influence the length of the corolla or the character of the capsule and of its crown.

Riofrio informed me that a great difference was noticed in the bark of Uritusinga, according as it had grown on the sides of the mountain most exposed to the rays of the morning or of the evening sun. I hope that I may at some time receive specimens of these, and be able to test the difference. Our second Plate represents this third, or *Quina fina* variety, as drawn from Seemann's specimens. It appears to be a peculiar form of the *C. Condaminea* with very hirsute scrobicules: the leaf is more herbaceous, the substance is softer, and the veins are less marked than in the *Uritusinga*, the *amarilla* and *colorada del Rey*. It agrees rather more closely with the specimens of *C. Chahuarguera*, but the young stems are more pubescent and of a stronger habit, as if grown in a moist and warm situation.

The *Crespilla negra* is almost always associated in the importations with the true *Chahuarguera*, the "Rusty Crown Bark" of Pereira, which forms the largest portion of many parcels of bark from Loja. This possesses nearly the same fragrance as the preceding, and appears to be in other respects equal to the *Quina fina*. I have even found it superior in the proportion of alkaloids, perhaps owing to its stronger growth. The larger pieces occurring occasionally amongst the Rusty Crown bark, show the connection existing between the *Chahuarguera* and the knotty sort of M. Jos. de Jussieu. Indeed, this term (*noueux*, knotty) might almost be applied to the *Chahuarguera* as a generic description, as it is a bark having a peculiar tendency to throw up corky excrescences. These appear in the form of small warts, even on the slenderest quills of the Rusty Crown bark. In other respects this bark is so well known, and has been so often and so fully described,* that I need not dwell upon it further than to mention the larger and coarser quills which are sometimes singly mixed with the ordinary Rusty Crown bark, and sometimes are found with other varieties of Loja bark. These larger and thicker portions of the *Chahuarguera* are particularly rich in the Cinchonidine of Pasteur, an alkaloid which is found more or less associated with Quinine in most of the sorts of this bark, and forming, with other alkaloids, a total percentage of from two to three parts in a hundred. This is interesting, as connected with the cure of the Countess of Chinchon, since this was probably due in great part to this alkaloid, which is indeed one of great efficacy, and entirely to be relied on, as I have myself ascertained, in the cure of intermittent fevers. This has been sufficiently shown in the account of one hundred and eighty cases of intermittent fever treated in the Philadelphia Hospital by Dr. Cullen, as reported in the American Journal of Medical Science for January, 1855. The therapeutic agent is called Sulphate of Quinidia, which is the commercial name; but since it is described in the paper as unaffected by the chlorine and ammonia test, it must be as above stated.†

The first Plate represents the fruticose varieties of the *C. Condaminea* (according to Pavon, of the *C. Chahuarguera*), which afforded the celebrated "Red" and "Yellow King's Bark." In the time of the Spanish dominion, these descriptions were reserved for the exclusive use of the Royal Pharmacy at Madrid, from which circumstance the term "Crown Bark" was derived. Such, at least, was the understanding, and such the origin of the title *del Rey* (Latinized as *regius*), which thus

* See especially Schleiden's 'Pharmacognosie,' pp. 273, 274, for an accurate description; also Pereira, 'Materia Medica,' vol. ii. part 2, pp. 1635, 1639.

† In addition, I may remark that I have separated Cinchonidine in large proportion from the commercial Sulphate of Quinidia, sold at Philadelphia. Dr. Herapath has also described a similar analysis of the same in a recent paper presented to the Royal Society.

established a certain prestige in its favour, and the *Cascarilla colorada del Rey* and the *amarilla del Rey* were long celebrated as the finest sorts of Peruvian Bark. The name has since passed over* (together with the renown) to a totally different bark, the product of the far richer *Cinchona Calisaya*, Weddell, of Bolivia, now become by general consent the "Cortex Chinæ flavus regius" of the different Pharmacopœias.

Ruiz states,† in the unpublished 'Compendio,' that the two species of *Cascarilla colorada del Rey*

* So far at least as relates to the *Amarilla del Rey*. The "H.O." and a *Crown* were brands adopted, in the time of the Spanish dominion, for two different sorts of bark, which are both included under the latter title "Crown Bark," but the former is still a distinctive appellation.

† "De la Quina llamada comunemente de Loja, y en el Peru Cascarilla fina de Loja.

"Segun la relacion que desde Loja me remitió el botánico Don Juan Tafalla (que en el año 1805 recorreo los montes de Uritusinga (ó Pico de Loro), el Boqueron, Macos, Anganuma, Anta, Cajamuna y varios otros de aquella Provincia) constituyen la suerte superior de Quina de Loja las cortezas de dos exquisitas especies de Chinchona, conocidas por aquellos cascarilleros ó peones recolectantes con los nombres de *Cascarilla colorada* y *Cascarilla amarilla*. . . . Añade Tafalla, que de estas dos especies son las Quinas que anualmente se remiten al Rey desde Loja en cantidad de cuatrocientas y cuarenta arrobas.

"Tambien se colecta esta suerte de Quina en las Provincias de Cuenca, Jaen de Bracomoros, Cajamuna y otras, en donde los cascarilleros y tratantes las mezclan casi siempre con otras especies, conocidas allí con los nombres de *Crespilla mala*, *Crespilla buena*, *Pata de Gallinazo*, *Ahumada*, *Palo blanco*, *hoja de Palton*, *hoja de Lucma*, *hoja de Zambo* y otras.

"Los tratantes mezclan tambien con las referidas dos especies las llamadas *Peruviana fina*, *Delgada* y *Anteada*. Ciertamente la suerte de *Quina de Loja*, quando se logra de las dos *colorada* y *amarilla*, las cuales se disputan su superioridad, ya mezclan dos ó separadas, sin adictamento de otras inferiores, produce admirables efectos.

"No es ménos activa que estas dos la *Crespilla buena*, la quale llega aunque pocas veces solo á España; por lo comun viene interpolada con las dos anteriores y muchas veces con otras de las mas serviles.

"Por ahora quedan bajo del nombre de Quina de Loja las dos especies de *Cascarilla colorada* y *amarilla* por ser la que vienen de aquella Provincia con mas estimacion á Europa. El diagnóstico que presentó de esta Quina, contiene los caracteres que prestan las cortezas de aquellas dos especies mezcladas segun se encuentren en el comercio.

"M. de La Condamine y demas naturalistas que hasta el dia han escrito de la Quina de Loja no nos han presentado aquellas relaciones exactos y descripciones completas que se requieren para decidir, como si debe, sobre una materia tan interesante: ántes bien por haber creído todos ellos que las Quinas de Loja eran cortezas de una misma é idéntica especie.

"Se han copiado y al mismo tiempo se han contradicho los unos á los otros, ocasionando confusiones en el comercio de esta preciosa droga.

"*Diagnóstico ó Senales característicos de las Cortezas de las dos Quinas, que como mas estimadas corren en el comercio con el nombre de Quina de Loja. (a)*

"*Superficie*, resquebrajada é con grietas transversales mas ó ménos notables, con algunas escabrosidades y granujos, en algunos cañutillos ó cañas.

"*Enves*, pardo mas ó ménos claro en unas cañas, pardo con muchos cenicientos en otras, negrillo del todo en varios cañutillos, y negrusco manchado de ceniciento en otros.

"*Color interior*, acanelado claro en unas cañas, y fulvescente ó rojizo, que tira á leonado mas ó menos subido, en otras.

"*Encañutamiento*; se arrollan perfectamente las cortezas, recubriendo la una margen á la otra; pero en algunas cañas se halla cada margen revuelta hacia dentro, formando en este caso una caña melliza; tambien se encuentran muchas cañas á medio arrollar. Las cortezas de los nudos son unas planchuelitas cortas y anchas, con las margenes poco arqueadas.

"*Grosor*; los cañutillos son por lo comun delgados desde el grueso de una pluma de escribir hasta el grosor del dedo pequeño.

"*Carnosidad*, apénas de media linea de grueso, pero en algunas cañas es de cerca una linea y en los cortezoncillos de los nudos para á veces de dos lineas, mediamente compacta en unas cañas, en otras algo porosa.

"*Peso*; los cañutillos delgados son poco pesados por su poca carnosidad, muy los cortezoncillos de los nudos son bastante pesados.

"*Consistencia*, un poco resistente al tiempo del troncamento.

"*Quebro*, sin barbillas ni fibrillas en muchos cañutillos, pero en otros se advertien bastantes barbillas cortas y algo largas en los cortezoncillos.

"*Zugo gomoso-resinoso*, abundante en muchas cañas y que con una lenze se distingue muy bien hacia la parte exterior de la corteza, formando un cerquito obscuro, en el qual se advertien á rayos del sol ciertos puntitos brillantes.

"*Olor*, aromático, grato, muy sensible quando se destapan las cajas ó vasijas en que hayan estado bien custodiadas las cañas.

"*Sabor*, muy amargo, bastante ingrato, especialmente él de los cañutillos pardos y él de los cortezoncillos de los nudos: con notable adstringencia, principalmente las cañas negrillas, pero se percibe poco acido en unas y otras cañas."

(a) "He omitido por ahora el nombre botánico de esta Quina, por que siendo dos las especies que constituyen la suerte mas apreciada en el comercio, no puede darse á las dos un mismo nombre é menester dar á cada una el suyo; lo que no es fácil hacer, hasta tener los materiales de las dos bien determinados y acondicionados, que espero me vengan del Peru."

and *amarilla del Rey* are those which are held in the greatest estimation in Europe; that he could not give the botanical name of this Cinchona, because the sort most appreciated in commerce consisted of these two species mixed together, and that consequently the two could not be suitably comprehended under one name; that of these two species were annually sent about 440 arrobas (say 100 cwt.) for the use of the King of Spain, a quantity which exceeds but little, if at all, that which arrives in most years in this country of these two sorts of bark. Ruiz is quite consistent in describing these barks as equally esteemed with, whilst they are distinct from, the *Quina fina*. Both qualities bear a high price in the market, but that of the *Quina fina* has recently exceeded.* The *Quina fina* is consequently at present the most valued, whilst the King's red and yellow Loja must now be reputed secondary, and the Chahuarguera still lower in the scale as to price. The *Quina fina* and the *Chahuarguera* are the most common sorts, then the *amarilla del Rey*, and least frequent of all the *colorada del Rey*.

The barks under consideration sometimes find their way unmixed into the English market; but more often as forming a portion of the best importations of Loxa bark, and mingled with other varieties of the *C. Condaminea*. The quantity received in England is rather limited, and on the Continent these particular sorts appear to be little known. Dr. Pereira has described, under the title, H.O. Crown Bark, *var. a*, the appearance of what I judge to be the *Cascarilla amarilla del Rey*. This formed part of a large parcel which we inspected together, which was partially mixed with the *Cascarilla negrilla*, the produce of *C. glandulifera*, and perhaps with other varieties.†

Pereira mentions this *var. a* as "consisting of quills remarkably devoid of Lichens, composed of a thin bark, which externally has a brown shrivelled appearance, being covered with numerous longitudinal wrinkles, and having very few transverse cracks. The transverse fracture is short. The internal surface is of a cinnamon-colour, but the fractured surface is pale-yellow." It may be added, that in the freshly-imported bark the colour of the internal surface is of a pale lemon-yellow, which at first contrasts remarkably with the rusty-brown of the external surface, and deepens into cinnamon-colour on being kept for some time, as I have observed in my specimens.

I take, as the most authentic and typical form of both these barks, the sections of branches with the bark attached, which are found in Pavon's collection in the British Museum. These have an additional guarantee for their correctness in being inscribed on the wood by the collector himself, with the name of the variety. The section of *Amarilla del Rey* (No. 20, Woods, B. M.) has this peculiarity, that whilst the diameter of the branch from which it was cut is two and a half by two inches, the bark itself is as thin as a wafer.‡ This extremely thin bark contains very few woody spiculæ. It consequently curls up upon itself very much in drying, and often forms a double volute. In the very

* One of our most experienced dealers remarked that a fine specimen of the *colorada del Rey* in my possession was "such as used to come in the good old days, when bark was 9s. and 2s. duty." It was probably at that time more valued than the *Quina fina*.

† The same mixture occurred in the time of Ruiz and Pavon. After describing the *amarilla* and *colorada del Rey*, Ruiz says that these barks are almost always mingled in commerce with those of the *Crespilla buena*, the *Chahuarguera*, the *Crespilla mala*, the *Pata de Gallinazo*, the *Ahumada*, the *Palo blanco*, the *hoja de Palton*, the *hoja de Lucma*, the *hoja de Zambo*, and others. (See the extract in page 6.)

‡ The comparative thickness of the bark of the *amarilla del Rey* is as 1 to 362, the circumference of the branch; that of the *colorada del Rey* is as 1 to 132.

small quills (or cañutillos) the distinguishing peculiarities almost disappear, and the bark approaches in appearance to the *Chahuarguera*, or Rusty Crown bark. Such at least is the character of Pavon's specimen in my possession marked by him, as comprising the bark of *C. Chahuarguera*, and of three varieties,* including the one under consideration. The whole together form a sample of *good Crown Bark*, and the variations, though perceptible, are not so striking to the eye as is often the case in the same barks when found in commerce. The inner surface of the *amarilla del Rey* is particularly smooth and even, which, as contrasted with that of the *colorada*, corresponds with the greater facility with which it is detached from the tree; but when this very smooth surface is examined by the microscope, it presents an amygdaloid appearance, owing to the presence of ovoid cells filled with a white substance, and imbedded in the yellow tissue of the bark. In no bark that I am acquainted with is this structure so remarkable as in the variety under consideration, and it was specially from it that Dr. Pereira drew up the description which is found in his *Materia Medica*.† I have since noticed the same cells in a bark (of a *Ladenbergia*?) in my possession, which I found devoid of any alkaloids, and I am inclined to consider these cells as identical with the *Krystallzellen* of Schleiden and of Schacht,‡ and not, as Dr. Pereira thought, as connected with the seat of the alkaloids in the bark. This peculiarity is, at all events, a striking characteristic of this bark: it exists in the section of *amarilla del Rey* in the British Museum, and it is also found, but less prominently, in quills in my possession of the *C. Chahuarguera*, Pavon.

Laubert describes the Loja bark in general as if it might be the produce of this variety; but though the sample in my hands of *Quina selectísima de Loja*, of Pavon's collecting, approaches nearly to it, the two are not perhaps absolutely identical, although I am inclined to refer both this and the bark brought home by Humboldt nearly to this type. The brown warts mentioned by Goebel as found on the Baron von Humboldt's specimen are very characteristic of the *amarilla del Rey* when grown in the shade. Indeed, some pieces present the ordinary appearance on one side, and the warty superficies on that which has occupied the reverse side of the branch.

M. Laubert,§ in 1810, thus describes the *Cascarilla amarilla del Rey*:—

“M. Pavon having had the politeness to show us a drawing of this tree, carefully made under the inspection of M. Tafalla, we have the pleasure of indicating the most prominent specific characters which we have remarked on this plate. ‘Cascarilla amarilla del Rey,’ or Royal Yellow Bark, is the name which it bears in the drawing, ‘foliis lanceolatis glandulosis obscure virescentibus, petiolo nervoque centrali sanguineis, flore rubro.’ M. Pavon has informed us this bark detaches easily from the wood, and that the most experienced ‘cascarilleros’ distinguish it by this separative character. Some days

* With this inscription: “Cascarilla Chahuarguera; Cascarilla amarilla fina del Rey; Colorada fina del Rey; Crespilla negra, parecida á la amarilla fina ó buena, todas de Loja. C. Chahuarguera.”

† Per. Mat. Med. vol. ii. part 2. p. 1619.

‡ Thus described by Dr. Schacht: “*Crystal-cells*, which differ from the cells of the parenchyma of the bark only in their contents, which consist of small, grey-coloured, granulated kernels, which, examined by a high power, appear to consist of crystals. Their contents disappear both before and after boiling in solution of caustic potash, and through the action of muriatic or nitric acid. Sulphuric acid, on the other hand, occasions the deposit of crystals of sulphate of lime. I unite with Schleiden in considering the contents of these cells as [kinate] of lime. These crystals are formed not only in the primary, but more frequently in the secondary bark. I consider them but little suited to aid in the discrimination of the bark, because their number appears to diminish with the age of the bark, whilst Schleiden believes that the time of collection exercises an influence on the quantity of these which the bark contains.”—Klotzsch, Ueber die Abstammung der Rothen Chinarinde: Berlin, 1858, p. 62.

§ Bull. de Pharm. ii. 1810, pp. 293, 294 (note).

after its extraction it is not to be distinguished from that of the *Colorada*. When it is fresh gathered, the colour of the internal surface is of a greenish-white, which soon changes into a faint yellow, augmenting in intensity until the desiccation is complete. The tree or shrub which produces it is of the same height, and exhibits the same structure as that of the red; yet M. Tafalla designates them in his drawings as forming two distinct species."

M. Laubert informs us* that the *Chinchona legitima* of Ruiz was of late years gathered for the Royal Pharmacy in the mountains of Uritusinga, Guatizinga, and Cajamuna, experience having proved to physicians that it ought to be preferred to that which is gathered at Quito, Jaen de Bracomoros, Cuenca, and other places. It would seem that the preponderance of Cinchonine which exists in the latter barks (which are the produce chiefly of the *C. macrocalyx*) had been found experimentally to be less beneficial. It is quite probable that the superiority of the *Cascarilla amarilla fina del Rey* may have been at first ascertained in like manner by experience, for it certainly appears to me to rest on a foundation of reality. I have carefully examined specimens recently imported, and find the relative percentage of Quinine is greater in this bark; as might indeed have been anticipated, from the pure Quinine-bitter taste: Cinchonidine (Pasteur) is present. The total amount of alkaloids is not apparently so great as in some of the other varieties of *C. Condaminea*. In the *Colorada*, Cinchonidine and Cinchonine predominate, with a trace of Quinine. The latter bark is also rich in cinchotannic acid, in gum and starch, and has a fair share of kinate of lime in its composition. A remarkably fine specimen of well-grown *Crespilla* bark (the *Quina fina de Loja*), recently imported, gave, on examination, one and a half per cent. of Cinchonidine and Quinine, implicated with much Cinchotannic acid and fragrant resin.

Of the *Colorada del Rey* M. Laubert says:—

"This is the name which this Bark bears in Peru: it is more common than the former, and is found in greater quantity among the barks used in the Royal Pharmacy. We have remarked in it the following characters:—the epidermis thin, but *rather thicker than that of the yellow*; wrinkled, of a chestnut-brown, and covered with silvery flakes and very small lichens; transverse fissures *more numerous* and very distinct; thickness somewhat less than a line; roundness or rolling complete; fracture clear, with little filaments in the internal part; size the same as the former, *internal surface not so fine*, and of a greyish-yellow; no perceptible difference from the *Amarilla* in the other qualities. It is often found in commerce with the Peruviana, the Delgadilla, the Carrasqueña, and others, but it forms with the first the assortment most in esteem.

"M. Pavon having had the politeness to show us the drawing of this shrub, we have recognized in it the following characteristics: '*C. foliis lanceolatis glandulosis, petiolo nervoque centrali sanguineis, flore rubescente.*' The two drawings appeared to us so similar, that we found only a slight difference in the colour of the flower, and were unable to discern on what character their specific difference could be established.

"At the moment of extraction this bark assumes internally the colour of saffron, though rather livid; during the desiccation its colour heightens, and approaches more or less to that of Ceylon

* Bull. de Pharm., 1810, p. 293, note.

Cinnamon. The shrub grows to the height of about three yards. The trunk is generally single, and covered with a rather rough bark. M. Pavon has informed us that this bark adheres more to the wood than the *Amarilla*, but it is more compact, and emits some little noise when detached from the wood."

According to Pavon,* these two barks grow intermingled in great abundance, on the same mountains, on the ridges of Uritusinga, etc., and various other situations of the Province of Loja, in the *pajonales* (*i. e.* places covered with herbage: see Weddell's Hist. p. 32) of the ridges, and in the ravines or glens, amongst shrubs and small plants, growing in a light and sandy soil with interspersed rocks. It is consequently probable that the place of growth is much more elevated than that of the *Crespilla* sort, since this latter was met with by Dr. Seemann, as he informs me, at about the same elevation as Loja itself. Loja is described by Villavicencio† as "situated in the lovely valley of Casi-pamba, between the rivers Malacatos and Zamora, almost on the flanks of the mountainous region of Villonaco, at an altitude of 2,448 varas [about 6,800 feet] above the sea. Its temperature is of 18° [R.], with a somewhat agreeable but moist atmosphere."

Humboldt‡ says that his *C. Condaminea* grows at an elevation of 900 to 1,200 toises (say 6,000 to 8,000 feet), and is exposed to a mean temperature of 15° to 16° Réaumur, which is about the mean warmth of the Canary Islands.

J. J. de Caldas, who visited Loja about 1805, described the Loja tree as growing under a range of temperature varying from 4° to 18° R. This writer therefore includes the sorts which occupy the higher situations on the mountains, and which, according to this author, rise to an altitude of 9,100 feet above the level of the sea.§

The Plate of the variety *Colorada del Rey* has been executed by Mr. Fitch with his usual skill and fidelity, from specimens collected by Pavon, and now extant in the herbarium of Sir Wm. Hooker, to whom I am indebted for the opportunity of making these subservient to the illustration of the species, and also for much courteous assistance.

I found at Berlin, in the collection at the Royal Museum, under the care of Dr. Klotzsch, a reference to these specimens in the following ticket attached to samples of the barks from the collection of Pavon, and in his handwriting, as follows:—"Species 31. C. Chahuarguera, las cascarillas.—*Amarilla fina del Rey*, No. 550, 712.—*Colorada fina del Rey*, No. 549, 711." These numbers I afterwards found to correspond with those which are attached to the botanical specimens at Kew, which are thus authenticated as belonging to the barks of these particular varieties. Duplicates of these numbers also exist in the Royal Museum at Madrid, with the full designation, as given above, attached to botanical specimens of the varieties. Mr. Fitch has since sketched these, and they correspond exactly with those at Kew. The *Colorada* and *Amarilla del Rey* are so similar, that I have not thought it needful to present drawings of both, simply indicating the difference in the leaf and in the flower of the *Amarilla*. The shaded portion of the Plate No. X. in the 'Plantas Equinoctiales,' moreover, represents very accurately the *Amarilla del Rey*, the leaf is more pointed, and also broader in proportion to the length than in the *Colorada*. A much more important difference is seen in the flower. I

* MSS. l. c.

† Geogr. del Ecuador, p. 443.

‡ Lambert, Illus. p. 50.

§ Translation by Dr. v. Martius in "Flora," No. 25, 1846.

remarked in my examination of Pavon's collection in 1852 (p. 8), that "the description of the red and yellow varieties by La Condamine would seem to indicate the *macho* and *hembra* varieties of the same tree. The botanical specimens in Pavon's herbarium of the *Roja* and *Colorada* are exceedingly similar; they both resemble Bonpland's *Condaminea* so nearly, that I can only suppose them varieties."

This conjecture appears to be verified by the dissections carefully executed by Mr. Fitch, and delineated without any knowledge of the information which Dr. Weddell has given us on the subject, or of my application of it to this case. The *Colorada* manifests a greater development of the masculine organs of fructification, and the colouring of the plant, as well as that of the bark, is correspondingly darker. The bark also is more robust in its character, thicker in proportion to the diameter of the wood, and more marked with transverse furrows, as I have before noticed. On the other hand, in the flower of the *Amarilla* the points of the style are seen projecting above the mouth of the tube, and the development of the anthers is much smaller in proportion.

In a recent visit to Paris, I took the opportunity of comparing the coloured drawing of Mr. Fitch with a coloured representation of the Bark-tree of Loja, executed on the spot by M. Jos. de Jussieu, and found amongst his papers, which have recently been transmitted to the Library of the Jardin des Plantes. In these MSS. the buds are said to resemble those of lavender, and the opened flowers to present an elegant carmine-colour;* but on the whole it appears to me that M. J. de Jussieu has attempted to represent the *Uritusinga* form of *C. Condaminea* rather than any of those which I have been describing. I think that the same observation applies to the tree figured by M. de La Condamine, which agrees with that of Jussieu, and both coincide with some well-preserved botanical specimens which I have just received through the hands of Don T. F. Riofrio, accompanied by particularly fine bark of the *Uritusinga* quality, much finer and larger (on the whole) than any now seen in commerce. This I hope to describe more particularly, but in the meantime must say that I entirely concur with M. Guibourt in the distinction which he has drawn between the Cinchona of La Condamine (*C. Uritusinga*?), which he names *C. academica*, and that figured by Humboldt in the shaded branch in the 'Plantes Equinoctiales.' The description in the 'Plantes Equinoctiales' includes the *C. Chahuarguera*, the *C. Uritusinga*, with all the other varieties of Ruiz and Pavon, under one form, first determined by La Condamine and described by Humboldt and Bonpland, and to which the name of *C. Condaminea* is now attached. Nevertheless I think it well to present Pavon's species under his own designations, as the confusion into which all had been thrown by too great fusion of the different forms of the Cinchona of Loja could not otherwise be cleared up. My remaining observations on this species will be found under the head *C. Uritusinga*.

* H. and B. say:—"Fleurs blanches, souvent d'une belle couleur rose." This variation probably applies to different forms of the species.



W. P. Sch. del. et lith.

CINCHONA CRISPA, Tafalla.
 C. Chahuarguera, Payon, var. Y.
 Quina fina de Loja. C. crespilla buena.
 "Fine Crown Bark"

W. West imp.

CHINCHONA CRISPA, *Tafalla.*

CHINCHONA CRISPA. *Quina fina de Loja, Cascarilla crespilla buena, Quina carrasqueña*, Tafalla, MS. sec. Ruiz in MS. Compendio, Mus. Brit.

C. Condaminea, H. et B., specimen florif. in pl. x. Pl. Equin. exclus. specim. fructif. et descriptione.

C. Chahuarguera, varietas [tertia], Pavon, Nueva Quinologia.

The accompanying Plate of this species (referred to above as Plate II.) is taken from the specimens gathered by Dr. Seemann as the true *Quina fina* of Loja. There can be no doubt, both from the circumstances elsewhere related, and from the specimens of bark brought home by this gentleman, that we have before us the source of the fine Loja bark of modern commerce. I think that the comparison of our drawing with the flowering branch delineated in Humboldt and Bonpland's 'Plantes Equinoctiales' also makes it manifest, that in both cases the same form is represented; and it is equally evident that the *Chinchona Uritusinga* of Pavon (which I believe to be the *Cinchona* of La Condamine, and consequently the true *Cinchona Condaminea* of the descriptions of Humboldt) is a different form,—so different, indeed, that Tafalla thought this a distinct species.

The particulars given by Humboldt in the 'Plantes Equinoctiales' and in the 'Description of the Cinchona Forests of America,' comprehend all the varieties of genuine Loja bark under one head, which arrangement, if adhered to, would render it impossible to classify the Loja barks proceeding from these several varieties,—each one having its own peculiar character. That of the *Quina fina de Loja* is exceedingly different from the old Loja barks as described by La Condamine, and as represented by specimens existing in our various museums. The internal cinnamon-colour of the smooth surface, so much insisted on by the old writers, is much less frequent in this modern Loja, which has in other respects the characteristics given with much minuteness by Tafalla, and reproduced under our head *C. Chahuarguera* in the *Diagnosis de la Quina crespilla*.* The brittle "vitreous" fracture there described is much insisted on by dealers. It is a very fragrant and a very pretty-looking bark; but, as I have elsewhere shown, very inferior in medicinal efficacy to the Loja bark produced by lofty trees,† whilst this has all the characteristics of what it really is, the product of a mere shrub. The very hirsute scrobicules distinguish this variety in a remarkable manner; and, if the dried specimens furnish any criterion, could scarcely be overlooked by any botanist. The *C. Uritusinga* differs widely in this respect.

The bark contains from 0.50 to 1.00 per centum of alkaloids, chiefly Cinchonidine and Quinidine.

* See note in page 3.

† Belonging to *C. Uritusinga* or *C. Chahuarguera*, "arbor procera," H. et B. Pl. Eq.



W. Eitch del et lith.

W. West imp.

CINCHONA COCCINEA Pavon.
 Cascarilla serrana ex Huaranda. N. 442. L. 662.
 "Acanelada" or Cinnamon-coloured Bark.

CHINCHONA COCCINEA.

CHINCHONA COCCINEA, foliis oppositis, petiolatis, heterophyllis, nervis venisque subtus pubescentibus, nervis utrinque petiolisque purpureis.

Arbor triorgyalis. *Truncus* solitarius, erectus, comâ frondosâ, ramosâ. *Cortex* cinereus, asper, nonnullis maculis nigris, rimis longitudinalibus transversalibusque. *Rami* erecti, tetragoni, parum diffusi, teneri, purpurascens. *Folia* opposita, petiolata, inferiora ovata, obovata, obovato-subrotunda ovato-subrotundaque, nonnulla subelliptica, majora pedalia; superiora subrotunda, ovata ovato-subrotundaque, alia obtusa, alia breviter acuminata, integerrima, nervosa venosaque, marginibus revolutis; superne glabra nitidaque, inferne parum nitida, per nervos et venas pubescentia, utrinque per nervos venasque purpurea. *Folia floralia* longe petiolata, lanceolata, decurrentia. *Petioles* parum curvati, pubescentes, subteretes. *Stipulae* interfoliaceae, oppositae, supra-axillares, sessiles, oblongae obovalesque, concavae, obtusae, cauli appressae, integerrimae, marginibus revolutis, aveniae, nervo centrali prominente, deciduae. *Pedunculi communes* axillares terminalesque, tetragoni, paniculato-subcorymbosi, diffusi, dum juniora pubescentes, vetustioribus pubescentia deciditur, bracteolis duabus oppositis linearibus subulares, ad basim suffulti. *Pedunculi partiales* iisdem bracteolis ad basim subdichotomi, omnibus persistentibus. *Pedicelli* bracteolis solitariis ad basim et in medio parvis. *Calyx* campanulatus, laciniis quinque ovatis acutis, purpurascens. *Corolla* extus pubescens, laciniis retroflexis, intus margineque tomentosis, villis albicantibus coccinea. *Antherae* pallidae, lineares. *Capsula* ovali-elliptica, dum matura purpurascens, bivalvis, valvulis basi hiantibus. *Receptaculum* lanceolatum.—*Habitat* in montibus Huaranda, de San Antonio de los Chillanes, et Huagro, regni Quitensis provinciarum. *Floret* Junio, Julio, et Augusto. *Vulgo*, *Cascarilla serrana acanelada*, y *Pata de Gallinazo*.—*Obs.* 1. Cortices sapore valde amaro, saponaceo grato praestant, et in febribus tertianis usurpari possunt. In usu non est. *Obs.* 2. Truncis incis, succum crystallinum exudant, posteaque in aureum colorem convertitur.—*Pavon*, *MS.*, *sub sp.* 18.

The vernacular appellation *acanelada*, or “cinnamon-coloured,” is applied in South America, and partially so in London, to a bark which is introduced in small quantities from the port of Guayaquil. It has been compared here to *Cassia lignea*. It is the *Quinquina jaune de Guayaquil* of Delondre’s Quinology, and is very well represented in plate 10 of that work. The description given at page 32 is equally correct; and I have pleasure in translating the notice and transferring it to these pages. M. Delondre says:—“The barks of this Cinchona are involuted and very long; their colour has some relation with that of Chinese Cinnamon.* The external surface shows longitudinal wrinkles, shallow and near together, with traces of a very thin epidermis. The internal surface is of a browner colour, with a smooth and very compact texture. The fracture is resinous at the exterior, and with short fibres at the interior portion of the bark. The thickness is three or four millimètres. The taste is bitter, piquant, and without astringency. It has yielded thirty parts in a thousand of Sulphate of Cinchonine, and three or four parts of Sulphate of Quinine. No doubt people will be glad to resort to it at a future time, when the other species are destroyed, and the world has returned to the use of Cinchonine, but at present it is not valued, and, as far as we know, but little of it has reached Europe.”

The specimens of Pavon in the British Museum, and also in my collection, present us with a

* *i.e.* *Cassia lignea*, Pereira.

kind of Jaen-looking bark, in coarse, twisted, white-brown quills, with a peculiar mamillated appearance, owing to some obscure warts. The colour of the bark is concealed by the white epidermis, and moreover the specimen does not appear to have been carefully dried.

The name points to the same district as that from which is derived the "Jaune de Guayaquil" (marked by M. Delondre, in a ticket attached to a specimen in my possession, "Jaune de Quito"). "Serrana" means "growing in the mountains," and the mountain districts named are in the vicinity of Quito, and the same in which the *C. succirubra* (red bark) abounds. Weddell mentions the districts between Chillanes and Guaranda as the habitat of the red-bark tree, and Don M. Villavicencio, in his 'Geografia del Ecuador,' describes the sides of the hills near San Antonio and Chillanes as rich in red bark of great value. The red bark from these districts comes equally by way of Guayaquil.

Huaranda is now found in the maps as Guaranda, whilst Huayaquil, as Pavon spells the name of the port, has been modified in the opposite direction, and is always called Guayaquil. In the Quichua language, from which these names are derived, the pronunciation would seem to resemble that of the English *w*.*

Guaranda, according to the 'Geografia de la República del Ecuador,' already quoted,† is situated in 1° 34' of south latitude, and 0° 28' west longitude (from Quito), on the flanks of Chimborazo, on the margin of the river Guaranda, with a mean temperature of 15°. The nature of its soil is micaceous schist.

I have only to add, in concluding my remarks on this species, that it appears to be quite distinct from the *Chinchona corymbosa* of Dr. Karsten. This I have ascertained by communication with Dr. K., to whom I sent Mr. Fitch's plate of the *C. coccinea*, and who obligingly forwarded to me in return his plate of the *C. corymbosa*, together with his opinion (in which I entirely concur) of the specific difference of the two plants.

* Dr. W. says,—“L'articulation indiquée par le signe *w*, à cause de l'analogie qu'il y a entre elle et le double *v* des Anglais, est écrite dans les vocabulaires *gu* ou *hu*.”—Weddell, Voyage dans la Bolivie, p. 556.

† Pages 336–338.



W. Fish del et lith.

W. Fish del.

CINCHONA PALALIBA. Ruiz et Pavon.
 (Cascarilla Palo-blanco. N.556. L. 718.)
 Cascarilla con Hojas de Zambo. N.527. L.759.

CHINCHONA PALALBA.

CHINCHONA PALALBA, foliis oppositis, petiolatis, ovatis oblongisque, undulatis, decurrentibus, pubescentibus, acuminatis, pedunculis paniculatis.

Arbor 4-5-orgyalis, comâ satis frondosâ, ramosâque. *Truncus* teres, erectus, solitarius, cortice extus fusco-virescente, maculis nonnullis cinereis, muscis plurimis vestitus, *cortex* viridis dum recenter incisus, sapore amarissimo, fastidioso, in masticatione saliva volvitur lacticiniosa. *Rami* diffusi, erecti, teretes, cinerei: *ramuli* tetragoni, angulis obtusis dilute purpurei, pubescentes, nonnullis lineis oblongo-linearibus sparsis. *Folia* opposita, petiolata, ovata oblongaque, decurrentia, undulata, integerrima, acumine obtuso, supernis glabra, infernis pubescentia magisque per nervos et venas magnas. *Petioles* teretes, pubescentes, rosacei, basi incrassati. *Stipulae* duæ, oppositæ, interfoliacæ, supra-axillares, cauli appressæ, integerrimæ, marginibus retroflexis, nervo centrali subtus prominente, carinata, deciduæ. *Pedunculi communes* axillares terminalesque, tetragoni, paniculati, foliosi, pubescentes: *partiales* dichotomi, pubescentes, bracteolis oppositis subulatis ad basim insertis. *Pedicelli* biflori solitariique; bracteolis parvis, solitariis, subulatis, ad basim et in medio insertis. *Calyx* dimidium rosaceus. *Corolla* pubescens; laciniis ovatis, acuminatis, reflexis, superne villosa-tomentosis, villis albicantibus. *Antheræ* lineares, luteæ, supra faucem parum exsertæ. *Capsula* oblonga, angusta, sulcis duobus oppositis angulis quinque obtusis: valvulis duabus, basi hiantibus.—*Habitat* in collibus Auganuma et Macos dictis, Vilcabamba ditione, Loxa Provincia. *Floret* Junio, Julio, et Augusto. *Vernacule*, *Cascarilla Palo blanco*; hujus speciei varietas ab incolis *Cascarilla con hojas de Zambo* appellatur, et in eisdem locis intermixta vegetat.

Cortex in medicina ignota, et in commercio.* *Pavon, MS., sub sp. 27.*

C. Pelalba, *Pav. Quinol. ined.*—DC. Bibl. Univ. Prod. iv. 355!—C. foliis subrotundis, vix apiculatis, membranaceis, in petiolis et utrinque in nervis hirsuto-velutinis, inter nervos subtus velutinis, supra subpuberulis; fructibus oblongis, teretibus.

This species has not been noticed by any recent botanist. Dr. Weddell, in his valuable ‘Histoire Naturelle des Quinquinas,’ seems even to doubt its title to a separate place in the family group. Nevertheless it appears, from Pavon’s description and from the drawing executed by Mr. Fitch from specimens of his collection, to have a character truly specific.

The bark, as represented in the specimens of Pavon in my possession, is of very inferior character, and it still has the same reputation, according to Riofrio, who marks it as “*de muy mala calidad*” (of very bad quality). It is not, I think, introduced into this country except as an occasional adulteration. It resembles much the other white-coated barks, especially the *C. lucumæfolia*. The name *Palo blanco*, or “white stick,” and *Hojas de Zambo*, or “Quince-leaved,” seem to be applied indiscriminately. The botanical specimen of the *Palo blanco* in the collection of Lambert in the British Museum, appears to be identical with that of the *Hojas de Zambo* at Kew, from which latter our drawing has been made. There is however a slight difference (possibly accidental) in the size of the capsules in the two specimens.

* *Observat.*—“Los Peones cascarilleros que extrahen las Cortezas, confunden esta variedad con la verdadera especie del Palo blanco, denominándolas ya á la una y á la otra variando los nombres, llamando Palo blanco á la Cascarilla que se llama Cascarilla con hojas de Zambo, y otras al contrario.”—*Pavon, MS., l.c.*



CINCHONA MICRANTHA. Ruiz et Pavon, var. β . flor. albis. Poeppig.

2. varietas alpestris. (legit Poeppig.)

1. *Cascarilla provinciana* blanquilla.

2. *Cascarilla provinciana* negrilla.

"Grey Bark" of English Commerce.

CHINCHONA MICRANTHA.

CHINCHONA MICRANTHA, foliis oppositis, petiolatis, ovalibus obovatisque, glabris; floribus minimis, paniculatis.

Arbor 10–15-orgyalis, comâ frondosâ. *Truncus* solitarius, erectus, teres; cortice scabro-fusco-cinereo, sapore valde amaro, acidulo non ingrato; in febribus tertianis usurpari potest; in commercio ignoto. *Rami* patuli, teretes, cortice fusco-nigrescente: teneri foliosi, obtuse tetragoni, glabri. *Folia* opposita, petiolata, ovalia obovataque, integerrima, obtusa, acumine brevi, ampla, marginibus revolutis, patentia, ut plurimum quadripalmaria, supra nitida, glaberrima, subtus nervosa, venosa, nervis purpureis; glandulis obovatis, subtus concavis, supra prominentibus, in foliis adolescentibus circum villosis, in senioribus deciduis, ad nervorum axillas insertis. *Petioles* breves, vix pollicares, supra plano-canaliculati, subtus semiteretes. *Stipulae* supra-axillares, interfoliaceae, oppositae, ovatae, integerrimae, connatae, caducae. *Panicula* maxima diffusa, subracemosa, foliosa, floridissima, tomentosa, helvolo colore. *Pedunculi* vix striati, tetragoni, compressiusculi, axillares terminalesque, *communes* brachiati, *partiales* oppositi alternique, omnes bracteis ovato-subulatis, oppositis, persistentibus, ad basim pedunculorum pedicellorumque insertis. *Flores* numerosi, in corymbos parvos multifloros congesti, subsessiles; bracteis minimis, ovatis, acutis, persistentibus ad basim et in medio pedicellorum. *Calyx* minimus, quinquedentatus; denticulis acutis, dilute purpurascens. *Corolla* parva, ut plurimum trilinearis, extus tomentosa, albicans. *Limbus* patens, laciniis quinque intus villosis-tomentosis, villis albicantibus extus rubescens. *Antherae* lineares, intra faucem inclusae, luteae. *Capsula* oblonga, acuta, leviter decemstriata, fusca, calyce coronata, a basi ad apicem dehiscens. *Semina* fulva, alâ lineari utrinque acutâ inaequaliter lacerâ cincta.—*Habitat* in Andium montibus altis, frigidis, et nemorosis, versus vicum S. Antonio de Playagrande, ubi Johannes Tafalla, anno 1797, eam observavit, et iconem, cum nonnullis exemplaribus siccis, et descriptionem, nobiscum communicavit. *Floret* Maio, Junio, et Julio. *Vulgo*, *Cascarilla fina* incolae nuncupant.

Cinchona micrantha, β *oblongifolia*, Weddell, 'Histoire Naturelle des Quinquinas,' p. 52, tab. xv.

Cinchona micrantha, var. *a*, flor. extus roseis; var. β , flor. extus albidis, Poeppig, Reise, ii. 261. (TAB. NOSTR. 1.)

Cinchona glandulifera?, varietas alpestris, Poeppig, l. c. (*C. Reicheliana*, How.) (TAB. NOSTR. 2.)

This species of *Cinchona*, which forms apparently a lofty and elegant tree, was discovered by the botanist Tafalla, an associate of Ruiz and Pavon. He examined it in the year 1797, having met with specimens in the cool and shady forests of the mountainous tracts of Chicoplaya, Monzon, and San Antonio de Playagrande. All these places are in the Huanuco district, where this species abounds, and forms a large proportion of the importations of barks which we receive by way of Lima, and which, from this circumstance, are called "Huanuco" or "Lima Barks," or more frequently, in English commerce, "Grey Bark," from the prevailing colour of the epidermis.

The same species is met with in Bolivia, and has been well described by Weddell. I cannot trace any specific difference between a specimen of "*C. micrantha*, R. and P., var. β , *oblongifolia*, Wedd.," given to me by this gentleman, and gathered by him in the valley of Tambopata, Province of Carabaya, and another for which I am indebted to Dr. Reichel, and which was collected by Poeppig, in the woods of Cuchero, in the district previously mentioned.

From this last specimen* Mr. Fitch has made his drawing, which has this advantage, that it shows us with certainty the origin of the bark brought home by Poeppig, and unquestionably representing the

* Labelled, by Poeppig himself, "*Cinchona micrantha*, R. and P., *a*, flor. albis (it is β in his published Travels), Cascarilla provinciana blanquilla var., Peruv. Suband. In sylvis ad Cuchero, Jan. 1830."

Cascarilla provinciana blanquilla, or silvery "Grey Bark" of commerce. Poeppig found two varieties, distinguished by the different colour of the flowers. He says,* "The tree is of considerable circumference, flowers in February, and often yields 8–10 arrobas (200 lbs. to 250 lbs.) of dried bark. This (Cuchero) sort is distinguished from that met with at Huanuco by a striking whitish colour, and a greater roughness of the upper surface. It is thicker and more woody, its fracture is more splintery, and the colour is clear cinnamon-brown." Cuchero furnishes therefore a superior kind of grey bark, which, according to Poeppig's samples in my possession, would fetch a higher price in the market than that sort which, as being the product of the latter district, is more strictly called *Huanuco*. This latter sort is distinguished by a glaucous derm, a periderm which easily exfoliates, and an abundance of longitudinal wrinkles.

I have availed myself of Mr. Fitch's skilful aid in the dissection and representation of another variety, also gathered by Poeppig, and apparently the source of the *Cascarilla provinciana negrilla*, a peculiarly fine description of Lima or grey bark,—indeed *the best of all*,—according to the inscription† copied by Dr. Reichel from Poeppig, and attached to a specimen of the bark which he has given to me. This plant does not appear to have met with any appropriate appellation, assuming that it differs‡ from the true *C. micrantha*. I have therefore given it the name *Cinchona Reicheliana*, as an acknowledgment of much valuable assistance afforded me by Dr. C. F. Reichel in the pursuit of Quinology, a study interesting to us both, and rendered still more so by our mutual regard.

I have also a specimen of another more rotund-leaved variety, gathered by Poeppig, and given to me by Reichel, with the inscription, "*Cinchona micrantha*, R. et Pavon, Andes Peruviae, leg. Poeppig, 1829, Herbar. Reichelii." I think this is probably the same as that mentioned by Lindley,§ "with

* Poeppigs Reise, ii. 261.

† "No. 48, Sammlung Reichels. *Cascarilla negrilla fina*, a Cad. *provinciana-negrilla*. *Cinchona glandulifera*, R. et P., varietas *alpestris*. *C. caduciflora*, Klotzsch, *omnium optima*, Peruvia, 1829, Cuchero; Poeppig leg. et determ." The specimen of the plant in flower which I have represented is named by Reichel "*Cinchona caduciflora*, Klotzsch, Andes Peruviae, 1829, leg. Poeppig, Herbar. Reichelii." This exactly agrees with a fine specimen, also gathered by Poeppig, in the Museum of the Jardin des Plantes, at Paris, inscribed, "*C. glandulifera*, R. et Pav.?, *Cascarilla negrilla* Peruvianorum. Peruv. Suband., Poeppig." This is marked by Weddell, "*Cinchona micrantha*, Wedd. Note.—Le nom de *Casc. negrilla* s'applique ord. à l'écorce du *C. glandulifera*, avec lequel Poeppig semble avoir confondu cette espèce." It is therefore in Weddell's judgment his *C. micrantha*. According to Mr. Fitch's dissections, it is remarkably a *macho* form of the plant (agreeing more in this with the plate in Weddell's 'Histoire'), whilst the *blanquilla* var. is the *hembra* form.

I owe to the kindness of Dr. Reichel a specimen of Lima bark, with the inscription, "No. 51, Sammlung Reichels, Lima Loxa China, Von Bergen, 1833, aus v. Bergens Sammlung eigenhändig! *Cascarilla negrilla ordinaria*, Reichel et Poeppig." This seems to me to agree in part with the *Cascarilla provinciana negrilla* which I have just described. A specimen of Huanuco bark from the same gentleman is labelled, "Alte, starke Huanuco-China des Handels, aus v. Bergens Sammlung, 1832, von *Cinchona micrantha*, nach Poeppig, Ruiz et Pavon.—*C. scrobiculata*, Hb. et B., *C. ovata*, Weddell, Schleiden, abstammend." As far as I can ascertain, this specimen contains portions of the bark of *C. nitida* and of *C. micrantha* (Cuchero), but of neither of the others mentioned. The *C. scrobiculata* is wholly different from the *C. micrantha*, in the bark as well as in botanical characteristics, and the bark of the *Ladenbergia caduciflora* could only be present as an adulteration. The *C. ovata* is equally foreign to the grey barks, and does not grow near Cuchero (see Poeppig, Reise, ii. 261). I see that Dr. Klotzsch, in the publication of 'Hayne's Reliquiae,' in 1843, agrees with what I have said in ascribing the *Cascarilla negrilla* of Poeppig to the *C. micrantha*. He says, "Mag hier erwähnt werden, dass sämtliche Eigenschaften der Rinde, die Herr Poeppig der *Cascarilla negrilla* (eine Bezeichnung, die Ruiz, Pavon und Tafalla für *Cinchona glandulifera* brauchen) zuschreibt, der Rinde von *Cinchona micrantha*, Ruiz und Pavon (*C. scrobiculata*, H. et B.), angehören, wie die Vergleichung der Poeppig'schen Original-exemplare beweist." Sub *C. glandulifera*, Ruiz et Pavon, p. 15, 14 band, 2 heft. The sketches made by Mr. Fitch of the *C. glandulifera*, in Pavon's collection at Madrid, agree entirely with the plate, vol. i. pl. ccxiv., of the Flor. Peruv. The species differs altogether, both from the one under consideration, and from the *C. villosa*.

‡ The grounds for this assumption are the evident difference in the form of the leaves and in the texture of the bark from the normal *C. micrantha*. The capsules and seeds are unfortunately wanting.

§ Lindley, 'Flora Medica,' p. 413.

obovate leaves, and a small, compact thyrses of flowers." It differs in the texture of the leaf from the var. *rotundifolia*, Weddell. I am not aware whether this corresponds to a peculiar description of bark.

It becomes an interesting question respecting the variation of this bark in places such as Huanuco and Cuchero, only a few leagues apart, whether there are in the living plant any other indications of specific difference, or whether these are merely different *forms*, not even worthy to be designated varieties.

Dr. Pereira says,* "It is obvious to me that either this bark puts on several very dissimilar forms, or that the barks of several distinct species are confounded together under the same name. M. Guibourt appears also to have arrived at a somewhat similar conclusion; for after describing two sorts of *micrantha* bark, he observes, that it appears to him that they are not the produce of Poeppig's *micrantha*, which therefore cannot be identical with that of Weddell."

My own belief is, that careful observation on the spot would make it manifest that whilst there is but one species of the *C. micrantha*, there are, in all these instances of varying barks, distinct varieties. Thus whilst no specific difference can be traced between the dried specimens of *C. micrantha* brought by Weddell, by Poeppig, and those comprised in the collection of Pavon in the British Museum, forming probably part of those sent by Tafalla from Chicoplaya, the leaves in these latter are more coriaceous, and some slight difference may be traced in the form and size of the capsules.

It is from these last specimens, which represent apparently the *C. micrantha* as originally described by Ruiz and Pavon, that Mr. Fitch has introduced the capsules and seeds, as they are not found in my specimens from Poeppig.

The Bolivian variety produces a quality of bark differing much in its physical and chemical qualities from those we have been describing, and, in common with most of the *Cinchonæ* of Bolivia, abounding more in Quinine than those of the same species growing in Peru.

There yet remains to be mentioned, as the produce of the *Cinchona micrantha*, the sort of bark which is described by Messrs. Delondre and Bouchardat, in their 'Quinologie,'† as "Quinquina huanuco plat, sans épiderme" (planche iv.), and mentioned as gathered in the forests of Huanuco, and brought down to Callao in serons weighing 70 to 75 kilogrammes. This bark has sometimes been attempted to be sold as Calisaya bark, and has been known as "Peruvian Calisaya." Both the flat bark and the accompanying quill are well represented in plates iv. and v. of the work to which I refer. The authors imagine that the source of the bark is the *Cinchona nitida* of Ruiz and Pavon. This hypothesis, however, does not accord with the result of the comparison of specimens of the bark of *C. nitida* in Pavon's collection; and moreover in the Museum at Kew are specimens, brought by J. Maclean, Esq., from Lima, of three varieties of this flat Huanuco bark, the *red*, the *yellow*, and the *pale*, with the accompanying leaves and flowers, pointing clearly to this origin. The botanical specimens are marked (I think, correctly) "*C. micrantha*, Wedd.;" the only difference that is perceptible consisting in some variation in the colour and texture of the leaves.

The products of this species are consequently:—

1. Grey bark, of fine quality, in quills, from Cuchero.
2. Grey bark, in quills from Huanuco, the sort more strictly called Huanuco bark, and described as such by Delondre.

* Pereira's 'Materia Medica,' vol. ii. part 2, p. 1627.

† Page 27.

3. The flat Huanuco bark, in three varieties.

4. The varieties found in Carabaya and Bolivia, observed by Dr. Weddell.

I remarked, when describing these varieties in the 'Pharmaceutical Journal,' that "the influence of soil and climate on the vegetation of the *Cinchonæ*, and consequently on their production of alkaloids, is a point requiring further investigation. In every species I have yet studied, this appears to be very great." This view of the case is greatly strengthened by the observations of Poeppig, and by the very valuable testimony of a modern author. It is recorded in the highly interesting work Dr. Karsten has recently published, 'On the Medicinal Barks of New Granada,'* that the same species varies to a considerable extent in its products, even in the same forest, according to different climatic exposure. We need not then be surprised if a distance of more than five hundred miles, and probably great diversity in climatic conditions, cause the Bolivian sort of *micrantha* bark to vary greatly from that of the district of Huanuco, whilst belonging to the same botanical species, and still preserving a certain general resemblance in its appearance. Poeppig says that (about 1830) "the principal districts of the collectors of this bark are situated on what is called the Montaña de Huanuco, that is, in the woods which, commencing near Ceja, in the province of Huamalies, stretch eastward through the northern part of Huanuco, and especially abound in the Quebrada of Chinchao, also filling the valleys of the mountains of Muña, Acomayo, and Panatahuas, and losing themselves probably near the Rio Pacheta. The cascarilleros of Huanuco range through the eastern side of the Andes in that province, and skirting the Rio Monzon, reap a rich harvest in the valley of Huallaga, and in the extraordinary deep valleys and defiles, such as the Quebradas of Chinchao and Cassapi, which everywhere intersect and divide the country in this direction. At a greater elevation than I have stated, the cascarilleros of Huanuco do not collect bark, since only the shrubby *Cinchonæ* grow there, the bark of which sorts, *though very efficacious*, is found to be unsuited to the purposes of commerce. Neither do they spread themselves further north towards the Huallaga, since all the barks of those much warmer valleys are known to be *of bad quality*, and easily to be distinguished from the other Huanuco barks, and are either entirely thrown away in Lima, or sold at a very low price. For when some *Cinchonæ*, which are less powerful than the subalpine species, as being grown under an increased temperature, occasionally descend into the warmer valleys, their barks vary in their appearance as well as in their efficacy,—a fact which I had abundant occasion to verify in the Mission Socache, on the upper Huallaga. In the Cinchona forests of Huanuco, the collectors were very attentive even to variations arising from locality. Thus the principal dealers gathered the bark only from those trees which grew on steep declivities or on mountain-ridges. They rejected all the trunks, even when they stood grouped in promising clusters (*manchas*), if the ground was damp, the valley warm, and without circulation of air. For this reason the price of the produce varied considerably, even in small districts; for the higher and colder the place of growth was, the more value was attached to the bark."†

* Pages 17, 18, 19.

† Dr. Karsten gives the following graphic description of these peculiar climatic conditions, agreeing with Poeppig:—"Those *Cinchonæ*, which are rich in alkaloids, inhabit the peculiar cloudy region of the Andes, in which, during the rainy season, which continues for nine months in the year, a steady rain is only interrupted during the day by short gleams of sunshine interchanging with clouds and mist; whilst in that part of the year which answers to our winter, cold nights, in which the temperature of the air descends to the freezing-point, and which are enlightened by the twinkling light of innumerable stars shining in the dark-azure heaven, are followed by days in which the beams of the sun, piercing here and there through the

It is not probable that so much care is now used in the collection. Most parcels of "Grey Bark" comprise a considerable variety of qualities, and appear to contain the produce of several different species, but on the whole that of the *C. micrantha* greatly preponderates. Dr. Reichel, who has had long experience as to the character of the Huanuco and Lima barks which have been supplied to the German market, is of opinion that the importations of Huanuco bark before the year 1826 were chiefly composed of barks of the *C. nitida*, but those more recently received from Lima consist of the produce of *C. micrantha*.

The appellation *grey* refers in these species to the striking effect of the overspreading thallus of various *Graphideæ*, etc., forming sometimes groups, very pretty when carefully examined. It is scarcely needful to say that this circumstance shows nothing as to the kind or quality of the bark, further than as an indication that the tree has grown in an open situation, exposed to rain and sunshine.* Other kinds are occasionally quite as much adorned with this bright clothing, especially the Calisaya quill; and Gœbel has figured together, in his plate vii., the quill of Huanuco bark,† and that of *China regia*, (apparently *Calisaya pallida*), as thus resembling each other. If considered in reference to the colour of the bark itself when reduced to powder, the term 'grey' would be no longer applicable, but rather that of 'orange' or 'reddish-brown;' and, in conformity with this, the chemical examination of barks of this species discloses an abundance of deep-orange colouring matter, soluble in water, and though not (perhaps) absolutely peculiar to this kind, still highly characteristic of it.

The bark which Dr. Weddell brought home as that of his var. *a rotundifolia* (said to agree with the *C. cordifolia* of Rohde) would unquestionably pass in commerce as "Spurious Red Bark." The abundance of Cinchona Red in this variety agrees with Dr. W.'s statement, that the bark of the *C. micrantha*, when first stripped from the tree, assumes a blood-red colour. But the contrast with the Peruvian varieties is most striking, since in these the proportion of Cincho-tannic Acid is remarkably small. The highly membranaceous texture of a specimen of Weddell's var. *a rotundifolia* in my possession, if not also the shape, accords with the leaf of one peculiar variety of "Red Bark" recently sent me, and for fuller information respecting which I wait for some promised specimens from Ecuador. For the present

thick clouds, raise the temperature to 25° C. (20° R., 77° Fahr.), whilst the leaves are kept almost constantly bedewed by the continual mists. The mean temperature of this region is about 12–13° C. (10° R., 53·6° to 55·4° Fahr.)"

A peculiarly favourable aspect he thus describes:—"The trachytic rock was here overlaid by more than 100 feet height of boulders heaped together, in which the mountain streams, springing from the ice of the mountain-top, had hollowed for themselves narrow and deep beds, in which, as protected from the violent and ice-cold winds of the night, the vegetation of the forest mounts almost 2000 feet over its highest limits into the grass-covered region. These ravines, thus stretching upwards, are the channels by which the streams of air ascend, when the midday sun warms the leafy covering of the mountain-side. Here the mist first begins to form, when the strata of warm air, containing much aqueous vapour, mix with the colder atmospheric currents descending from the icy summits, and there ensues a frequently repeated alternation of thick mist, which entirely bedews the surface of the plants, and of warm sunbeams, which dry and warm the moistened leaves. This lasts till late in the afternoon, when misty clouds overspread the whole district until they are condensed by the cold of the night, to be again raised into vapour by the morning sun. This is the peculiar climate of those *Cinchonæ* which are rich in organic bases, as far at least as my observation extends, since the bark of the *Cinchonæ* growing in the ravine I have described, far above the normal limits of the forest-growing *Cinchonæ*, gave 3½ per cent. of sulphate of quinine, whilst the bark obtained from the *C. corymbosa* of the lower-lying forest, where the *Ladenbergia macrocarpa* began to appear, scarcely afforded 1 per cent."—Karsten, 'Die Medicinischen Chinarinden Neu-Granadas,' p. 21.

* "These trees grow on the high mountains, where it is cold at night, but sunny and mild by day, and where also other different trees, shrubs, and smaller plants cover the rocks and cliffs. They like a *free air, cold, water, and sunshine*. Shady and close situations are injurious to the full perfection of the bark."—'Quinologia,' under *C. officinalis*.

† Apparently the sort derived from *C. nitida*, to be described under that species.

I shall only remark that whilst the varieties of the *C. micrantha* thus verge on the one side towards the "Red Barks" of commerce, on the other they approximate perhaps even more closely to the *Calisaya* of Bolivia. An unnamed peculiar form of the *C. micrantha* was collected by Dr. Weddell, and recently shown to me by this gentleman, together with the rest of the collections which resulted from his last voyage. This specimen Dr. W. placed side by side with one of *Calisaya blanca* (which also diverges much from the normal type of the *C. Calisaya*), and the two were found to approach extremely near to each other. It is to be desired that this distinguished botanist, to whose 'Histoire Naturelle des Quinquinas' we already owe so much instruction, would add still further to our obligations by publishing some of these connecting links between the different species, which are in themselves exceedingly important, whether we regard them as species or as varieties. In the case of this unnamed variety of *C. micrantha* such information is still more to be desired, as, if I am not mistaken, the bark finds its way into commerce, and is rich in Quinine, thus contrasting remarkably with the *micrantha* barks from Peru.

The chemical examination of the Huanuco barks shows a considerable product in alkaloids, of which Cinchonine forms by far the largest proportion. In the smallest quills of inferior grey bark of commerce, corresponding with the *Provinciana* bark of Pavon's and of Poeppig's collections, and with the bark brought by Tafalla from Chicoplaya, I find from 1.2 to 1.4 of alkaloid in a hundred parts, and in the larger and finer quills a proportionately greater quantity; but the bark which corresponds to Poeppig's Cuchero variety gives as much as 2.70 per cent. of alkaloid, of which 2 per cent. must be regarded as Cinchonine.* This kind is much sought after for the Russian market, and may be regarded as of considerable medicinal efficacy; but this favourable estimate ought to be lowered in proportion to the less beneficial action of Cinchonine on the human frame.† These barks appear to contain, in addition to Cinchonine, but in smaller proportion, Cinchonidine, and in some cases Quinidine and Quinine. Kinic and kinovic acids are common to both the Huanuco and Cuchero sorts, as also gum and vegetable wax. In both the proportion of cincho-tannic acid is feeble. In the Huanuco sort chlorophyll abounds, but it is absent, or nearly so, in that from Cuchero.

The microscopic examination of the different specimens of *C. micrantha* shows a similarity of general structure, but with characteristic differences. The general character and arrangement of the cortical fibres is that characteristic of the more productive species of *Cinchona*. The lactiferous vessels are peculiarly large and abundant in the specimen brought from Huanuco by Poeppig, and less so in that from Cuchero, whilst in the *C. Reicheliana* they are entirely absent; an observation which, if confirmed by more extensive observation, would tend to show a difference of a specific character. The resin-cells, though present in the Huanuco specimen, are most abundant in that from Cuchero, which last coincides more fully with the specimen given me by Dr. Weddell: in this last the lactiferous vessels are smaller and less numerous.

* M. A. Erdmann, of Hanover, in the 'Annalen der Chemie und Pharmacie,' for December, 1856, describes that which he considered as a new base derived from flat Huanuco bark, and which he named Huanokin. M. de Vrij contends that this is simply pure Cinchonine. On the other hand, M. H. Hahn, of Hanover, has attempted to prove the contrary. See 'Archiv der Pharmacie,' for October, 1858.

† See Briquet, 'Traité thérapeutique du Quinquina et de ses Préparations,' pp. 458, 468.



W. Eichl. del. et lith.

CINCHONA VILLOSA, Pavon.
Cascarilla peluda, Jaen. 589. L. 7:3.
"Dark Jaen Bark".

W. West imp.

CHINCHONA VILLOSA.

CHINCHONA VILLOSA, foliis oppositis, petiolatis, oblongis, villosis, ramis flexuosis, floribus paniculato-racemosis nutantibus.

Arbor 8-10-orgyalis. *Truncus* erectus, teres, ramosus, comâ ramosâ frondosâ. *Cortex* subniger, asper, sapore amaro non ingrato. *Rami* flexuosi, tetragoni, dependentes, oppositi, brachiati, longi; teneri villosi, purpurascens. *Folia* opposita, petiolata, oblonga, obtuse acuminata, nonnulla acuta, juniora lanceolata, marginibus revolutis, dependentia, undulata, subtus villosiora, villis supra deciduis, nervosa, venosa, tenuia, glandulis nonnullis rotundatis, subtus concavis, marginibus villosis, supra prominentibus, ad nervorum axillas insertis, supra obscure viridia, subtus dilute. *Petioles* teretes, villosi, pollicares, basi incrassati. *Stipulae* duæ, oppositæ, sessiles, supra-axillares, erectæ, interfoliaceæ, ovales, obtusæ, villosæ, integerrimæ, cauli adpressæ, nervo centrali subtus prominente, deciduæ. *Pedunculi communes* axillares terminalesque, teretes, flexuosi, villosi, horizontales, paniculato-racemosi, oppositi; *partiales* bracteis duabus oppositis, parvis, ovatis, acutis, villosis, ad basim insertis. *Capsula* parva, oblonga, hirsuta, basi hians. *Semina* cum alis linearia. *Receptaculum* centrale, lineare.—*Habitat* in collibus Jaen de Bracamoros dictis. *Floret* Maio, Junio, et Julio. *Vulgo*, *Cascarilla peluda*.—*Observ.* Flores non vidit D. Joannes Tafalla, noster alumnus.—*Pavon*, *MS.*, *sub Sp.* 39.

C. Humboldtiana, foliis lanceolatis utrinque acutis supra denudatis* subtus ramulisque villosis, panicula glomerata villosa, dentibus calycinis brevissimis acutis, antheris sessilibus inclusis, stigmatibus exserto emarginato, capsulis ovatis hirtis glomeratis.—*Lambert*, *Illus.*, p. 7.

C. villosa. *Young branches* somewhat quadrangular, villous with long loose hairs. *Leaves* ovate-lanceolate or oblong-lanceolate, rather thin, acuminate but hardly acute, pointed at the base, not shining, the upper ones among the flowers, ovate; nearly free from hairs on the upper side, except the midribs, covered with scattered numerous shaggy hairs on the under side, especially the veins and upon the petioles. *Panicle* terminal, rather long, leafy towards the base, with very villous pedicels. *Calyx* tomentose all over, with a short half-5-cleft limb. *Corolla* . . . *Fruit* about half an inch long, oval, rather strongly ribbed, tomentose.—*Lindley*, *Flora Medica*, p. 422.

C. Humboldtiana, Weddell, 'Histoire Naturelle des Quinquinas,' p. 67. tab. x. B.

The town of Jaen de Bracamoros has given its name to some of the worst kinds of Peruvian bark, which are thence denominated, especially by the Germans, "pale," and "dark Jaen or Ten barks." The celebrated traveller Pöppig quotes the statement of M. La Condamine, that the barks from Jaen were so notoriously bad, that it was sufficient to cause the rejection of a parcel at Panama if it was known to be exported from Cherrepe, the usual port of shipment of barks from that locality. He conceives the reason for this inferiority to lie in the very warm temperature of the neighbouring region.† This little town is situated near the junction of the Chincipe river with the Marañon, almost on the boundary line between Ecuador and Peru. According to Baron von Humboldt, as quoted by Pöppig, the elevation of the neighbouring region is not more than from 200 to 350 toises (say 650 to 1,200 feet) above the sea, and its mean temperature is thought by the last-mentioned traveller to rise as high as that of the districts of the Huallaga, which are at about an equal elevation, viz. 26° C. (= 78·8° Fahrenheit, or about 21° R.) On the hilly portions of this warm and fertile region, and in other similar districts,‡ grows the somewhat lofty tree we are considering, and which probably would not bear the cold and the elevation favourable to the finer species. The same circumstances of warmth and moisture assist the production of foliaceous and filiform lichens, which (as

* Not so in the specimen drawn by W. F.

† Reise von E. Pöppig, vol. ii. p. 258.

‡ In Venezuela and New Granada, according to Karsten. See his 'Medicinischen Chinarinden,' p. 24.

observed by Pereira) abound on this bark. The bright golden-yellow of the *Sticta aurata* distinguishes some pieces; others are diversified with varieties of *Parmeliæ* and *Usneæ*; and on others powdery and crustaceous lichens abound,—the white, grey, and black patches are predominant, and of these some are peculiarly soot-like. It is probably of these last that Pöppig writes,* when, in describing the *Cascarilla negrilla*, he says, “The common people consider the greyish-green lichens as an integral part of the bark, and regard this as peculiarly precious when underneath the lichens is discovered a shining, black, velvet-like substance (apparently a byssus), in oval patches of some lines in thickness.” The aspect of the bark has probably a somewhat similar effect on buyers in this market; for this sort commands a good price, although, chemically considered, it is of the least possible value. A parcel of about thirty serons, coming by way of Guayaquil, has been sold quite recently at more than two-thirds the price of Calisaya bark; the value being estimated, no doubt, according to the handsome appearance of the medicinal article thus exposed for sale.

The best authentic specimen of this bark which I know,† is one brought home by Hartweg, and deposited in the Museum at Kew, with the inscription, “*C. villosa*, from the Cinchona forests of Loja.” The peculiar and straight-lying internal fibre is well seen in this specimen, and the very elegant arrangement of the different patches of lichen on the external surface. Less perfect, but similar in character, are the specimens from the collection of Pavon, as in my possession, and also as found at Berlin and Dresden, with the inscription, “*C. undulata*, olim *glandulifera*, No. 589, 743.” These numbers are those attached to the specimens of *C. villosa* found at Kew and elsewhere, from which our drawing has been made, the bark being called in the MS., and no doubt rightly so, *Cascarilla peluda*, “the villous bark.” The inscription goes on to state that Tafalla sent these barks from Chicoplaya, in Peru, and that it is there called *Cascarilla negrilla*. But the *Cascarilla negrilla* brought home by Pöppig as that of the *C. glandulifera* of Pavon (and which agrees with the description of Tafalla’s *C. negrilla* in the “Suplemento”), is a bark of wholly different character.

It is probable that both these barks—that of the *C. villosa* and that of the *C. glandulifera*—may be called *Cascarilla negrilla* in the Huanuco district, especially as Pöppig’s observations in reference to the black coating of the investing byssus seem to apply to the bark of *C. villosa*, more distinctly than to that of *C. glandulifera*.

Göebel gives a tolerably correct representation of this bark as the “dark Jaen bark, or Pseudo-Loxa,” in plate xiii. of his ‘Pharmaceutische Waarenkunde,’ accompanied by the following description (p. 68):—

“This kind is distinguished from the pale Jaen bark chiefly in the difference of the outer and inner surface. The form of the quills is that of the pale Jaen bark. The epidermis and the different layers of the bark are closely united together. The external surface is in this bark rougher and less smooth; in the smaller quills covered with long wrinkles and few cross wrinkles, but in older barks not only with long wrinkles, but with many small, irregular cross wrinkles. We also meet, on various

* Pöppig’s ‘Reise,’ ii. 261.

† Perhaps I should attach equal authenticity to the specimen No. 25 in the British Museum, which is very characteristic; also to the Woods, No. 27.

quills, with small scattered warts. The colour varies frequently on account of the numerous lichens. As seen in quantity, the first impression is blackish-grey and blackish-yellow; for we remark a number of black and straw-yellow spots (arising from adherent lichens) on this bark. When more closely examined, the greyish-white, straw-yellow, and brown-black colours interchange with each other. The inner surface appears, when freed from dust, to be somewhat darker than the 'pale Jaen Bark,' more cinnamon-coloured, and often with a shade of red."

This description suits so well the bark of *C. villosa*, and in other respects the coincidence of the *Cascarilla peluda* of Jaen is so complete with the "dark Jaen Bark," that I think there is little doubt of their identity. At the same time it must be considered probable that several different kinds of bark are comprised under the latter appellation, as is the case with the "Ashy Crown Bark" of English commerce, which is now attached to the product of the *C. macrocalyx*, of the *C. villosa*, and of other species.

Von Bergen's description of "the China Pseudo-Loxa, or dark Jaen Bark," seems to apply to this sort; but this author assigns the name *Nuova selva* (by which the bark of the *C. villosa* is known amongst the Italians) to the "China Jaen or pale Jaen Bark," and his plate does not accurately delineate the species.

Viewed microscopically, there is little to give a distinctive character to the bark of *C. villosa*, unless indeed that character be of a *negative* description. The resemblance is most to the barks of *C. pubescens*. The thick dark cellular tissue is probably the seat of a bitter gum which exists in this bark to the extent of three to four parts in a hundred. In this feature there seems to me a resemblance to the bark of the *Pimentelia glomerata* (Weddell).

I obtained a very fine characteristic sample from an importation from Cuenca, by way of Guayaquil, in 1858. This consisted of quills, generally about the size of a goose-quill, some a little larger, and about two feet in length. They were much convoluted in drying, straight-lying, but slightly sinuous; the surface varied with patches of ashy-white, grey, and sooty-black colour; the whole bearing a striking similarity to Pavon's specimen in my possession.

This, on examination, proved very deficient in Cinchonic character. The proportion of Cincho-tannic Acid was very small, as was also that of alkaloid, of which I could not discover more than two parts in a thousand of the bark, and this appeared to consist of Aricine.* Kinate of Lime seemed present in a feeble proportion; but gum and wax, mixed with dark-green chlorophyll, were abundant. Kinovic Acid was present. This sample sold for more than two-thirds the price given at the same sale for Calisaya quills, although not containing more than one-tenth the quantity of alkaloid found in this latter and more useful kind.

A previous importation consisted in equally long and much thicker quills, and, probably from this circumstance, gave a larger proportion of alkaloid, also of Aricine, rather exceeding seven parts in a thousand.†

This bark comes generally unmixed with other species, and has recently been imported rather

* As described by Gerhardt in his 'Traité de Chimie Organique,' t. iv. pp. 152, 153.

† Exactly 7·4 in 1000 parts of bark.

frequently. The high price which it commands will probably cause it to be still more largely introduced. This circumstance should not pass unnoticed by the physician, since it cannot be supposed that a bark which contains so small a proportion of alkaloid can exert a very beneficial effect on the patient. Especially doubtful must this appear, when it is understood that even this small quantity of alkaloid is of a different nature to that of the original and valued Peruvian barks, and that indeed its medicinal effects have not been at all studied, and must at present be considered as altogether of an uncertain character. The bark is well named PSEUDO-LOJA (LOXA).

On the whole, I must regard this species as standing very near the verge which separates the group of the *Cinchonæ* from the allied genera. The capsules, dehiscent from the base towards the apex, give it a place within the family circle to which, as to its essential characteristics, it seems barely entitled. It is almost to be regretted that a *Cinchona* so little *Cinchonaceous* should have been chosen to bear the name of that eminent philosopher who has recently been removed from amongst us, and whose intellectual endowments and services to the cause of science were of so remarkable a character.

Professor Lindley says (*l. c.*), "Why Pavon's expressive name of *C. villosa* should have been altered in Lambert's *Illust.* to *C. Humboldtiana*, I am at a loss to discover."

Lambert remarks that "this is a strongly-marked and very distinct species; there is none with which it can be confounded."



W. Fitch del et lith.

CINCHONA MACROCALYX, Raven.

W. West imp.

C. con Hojas redondas.

"Ashy Crown Bark."

CHINCHONA MACROCALYX.

CHINCHONA MACROCALYX, foliis oppositis, petiolatis, ovalibus obovatisque; pedunculis axillaribus terminalibusque, paniculatis.

Arbor triorgyalis, comâ frondosâ ramosâque. *Truncus* solitarius, erectus, teres: cortice crasso, cinereo-fusco, scabro; rimis transversalibus, nonnullis longitudinalibus; maculis nigris, albicantibus fuscisque; sapore satis amaro, acidulo, grato, in febribus tertianis propinatur. *Rami* tetragoni. *Folia* opposita, petiolata, ovalia, nonnulla obovata subrotundaque, tenera, cordata, acumine brevi obtuso, integerrima, rugosa, coriacea, crassa, nervosa, venosa, marginibus revolutis, supernis glabra, nitida, nervis venisque subtus villosis, villis hispidulis. *Petiolî* breves, teretes, hispidi, purpurei. *Stipulae* oppositæ, duæ, interfoliaceæ, ovales, cum brevi acumine, glabræ, integerrimæ, cauli appressæ, marginibus revolutis, nonnullæ obovatæ, deciduæ. *Pedunculi* communes, tetragoni, pubescentes, paniculato-corymbosi, axillares terminalesque; bracteolis duabus, oppositis, integris, lanceolatis: *partiales* bracteolis oppositis, lineari-subulatis, longis. *Flores* nonnulli, sessiles, alii pedicellati; *pedicellis* brevibus, pubescentibus; bracteolâ solitariâ, ad basim et in medio subulatâ, persistente. *Calyx* quinque-laciniatus, magnus, laciniis lanceolato-subulatis, pubescens. *Corolla* extus pubescens, rubicunda; laciniis intus villosis, villis albicantibus, retroflexis. *Antheræ* lineares, parum extra faucem exsertæ. *Stylus* brevis. *Capsula* ovalis, compressa, sulcis duobus oppositis, bilocularis, bivalvis, *valvulis* basi dehiscentibus. *Receptaculum* lineare.—*Habitat* in montibus altis, frigidis, Hualasco nominatis, in colle de Tapa dicto, Cuenca provinciâ Quito. *Floret* Junio, Julio, et Augusto. *Vulgo* *Cascarilla crespilla*.—Pavon, MS. *Nueva Quinol. sub Sp.* 28.

This well-marked species comprehends a number of varieties represented in the collection of Pavon. They differ in very slight particulars, such as the amount of pubescence on the leaf, which is greatest in a variety from Cuenca, called *Cascarilla con hojas un poco vellosas*, and in the length of the flower, so remarkable in the *Cascarilla con hojas redondas*, from which our Plate has been drawn. The latter sort is specially worthy of notice, as being largely imported, under the name of “*Ashy Crown Bark*,” in the London market: it is called by Guibourt “*Quinquina de Loja cendré, B.*” Its origin was traced out by Dr. Pereira and myself when we inspected together Pavon’s samples in the British Museum; but we were led to suppose, from the designation of “the round-leaved Chinchona,” that it was the *C. cordifolia*, var. *rotundifolia*, which was intended. It is however quite clear, from Pavon’s classification of his specimens, that it is otherwise, and the drawing made from a specimen in the British Museum shows distinctly this origin from the *C. macrocalyx*.

The specimen in my possession, to which Pavon has attached the name of *Chinchona macrocalyx*, as including no less than eight various sorts,* is indicative of the coarse and inferior fibrous crown barks which are all now included under the designation given above. It is, I think, the “*Quinquina de Loja, jaune, fibreux, de commerce actuel*,” of the French market.

The bark is much stouter, and with a more woody-fibrous fracture than that of the *C. villosa*, from which it is also distinguished by the more yellow-brown colour, and by the comparative absence

* The inscription is as follows:—“Quiebro de Loja, y de la Prov. de Parv. Cascarilla de Cuenca; Cascarilla de los Altos de Malasco; Cerro de Tapa; Quina amarilla de Loja; Chinchona cava; Chinchona de hoja redonda. *Chinchona macrocalyx* de la coleccion de Pavon.”

of lichens; whilst it is easily discriminated from the true Loja barks by the peculiar fracture, the surface covered with long wrinkles, and almost destitute of cross cracks (those which are found being feebly impressed), the more ashy-grey aspect, the more nauseous taste, and also by the frequent occurrence of pustular warts, caused by the bite of some insect. These are, however, not a diagnostic indication of this sort, as they occur also on the bark of the *C. villosa* and *C. pubescens*.

Chemically considered, the barks of *C. macrocalyx* must be considered inferior to those derived from the varieties of *C. Condaminea* at Loja. The yield in alkaloids is smaller (so far as my experience extends), and of the total percentage a larger amount consists of Chinchonine; Chinchonidine and a trace of Quinine forming the remainder of the product. They differ consequently much more from the bark of *C. villosa* than the somewhat similar aspect would at first sight suggest.

Viewed microscopically, the bark of *Ch. con hojas redondas* presents a peculiar aspect, owing to the arrangement of the cortical fibres in bundles, which thus oppose considerable resistance when a quill of some size is attempted to be broken by the hand. It is a very *woody* bark, and many of the pieces are quite flat, having dried without assuming a quilly form.



W. Fitch del. et lith.

CINCHONA SUCCIRUBRA, Pavon.

1. Cascarilla colorada ex Huaranda, 464.L. 669.

2. Specimen from the western slopes of Chimborazo.

"Genuine Red Bark"

W. West imp.

CHINCHONA SUCCIRUBRA.

CHINCHONA SUCCIRUBRA, foliis oppositis, petiolatis, ovatis ovalibusque; petiolis nervisque rubicundis, glabris, nitidis; pedunculis racemoso-paniculatis.

Arbor 6-7-orgyalis. *Truncus* solitarius, erectus; aliquoties duo tresve ex eadem radice repullulant. *Coma* frondosa ramosaque. *Lignum* compactum. *Cortex* fuscus, nonnullis maculis albicantibus; rimis transversalibus horizontalibusque. *Rami* erecti, nonnulli horizontales, teretes, *teneri* pubescentes. *Folia* opposita, petiolata, ovata ovaliaque, integerrima, acumine brevissimo, nonnulla subrotunda, glabra, superne parum nitida, nervosa, venosa, venis reticulatis, nervis venisque villosis, tenuia marginibus retroflexis. *Folia* superiora floralia petiolata, lanceolata, nonnulla sublinearia. *Petioles* subteretes, basi crassiores, pubescentes, rubicundi sicuti nervi. *Stipulae* duae, interfoliaceae, supra-axillares, oppositae, subamplexicaules, oblongae, sessiles, integerrimae, parum concavae, cauli appressae, deciduae. *Pedunculi* communes, axillares terminalesque, racemoso-paniculati, pubescentes. *Partiales* oppositi alternique, pubescentes. *Pedicelli* bracteolis lanceolato-subulatis, parvis, concavis, deciduis, ad basim et in medio rubicundo. *Flores* pedicellati, nonnulli sessiles. *Corolla* rubicunda, marginibus laciniarum ciliatis, villis albicantibus. *Capsula* oblonga, parum incurva, immatura rubicunda, bivalvis, basi hians. *Receptaculum* lanceolatum. *Semina* alis dilaceratis.—*Habitat* ad radices collium, ad declivia Sancti Antonii, in via ad Huaranda Provinciae Quitensis, locis frigidis. *Floret* Julio et Augusto. *Vulgo*, *Cascarilla colorada*.—*Observ.* 1. In arborum corticumque amputatione, succum lacteum primum profluit; postea, in colorem intense rubicundum transmutatur, unde *Cascarilla colorada* nomen oritur. *Observ.* 2. *Cortex* sapore valde amaro, acidulo, non ingrato praestat, et colore rubicundo sistit. *Vires et usus*: in febribus tertianis magno usu fit. In Pharmacopolio Regio hujus speciei ex Regno Quitensi, Loxa Provincia, et aliarum, magna copia transvehitur.—*Pavon, MS., Nueva Quin. sub sp.* 19.

Cinchona succirubra, Pavon, MSS.; arborea; ramis teretibus; ramulis obtuso-angulatis flavido-pubescentibus; foliis membranaceis magnis latissime ovatis petiolatis, utrinque brevissime attenuatis, supra saturate viridibus glabris subnitidis, subtus pallide viridibus puberulis, ad costam nervosque primarios pubescentibus; petiolis semiteretibus puberulis, supra canaliculatis; stipulis oblongis obtusis carinatis subpuberulis caducis; floribus congestis in paniculam terminalem interruptam dispositis; ramis floriferis pedunculatis pubescentibus erectis compressis trichotomo-ramosis, inferioribus foliosis superioribus bracteatis; bracteis subpersistentibus oblongo-linearibus, extus subpubescentibus carinatis basi attenuatis; calycibus turbinatis, basi bracteola minuta suffultis, tubo dense albido pubescente, limbo cupulari quinque-dentato rubescente sparsim pubescente, dentibus brevibus latis acutis, dorso carinatis; corollis hypocraterimorphis brevissime pubescentibus, tubo inferne attenuato, limbo quinquefido, laciniis ovatis acutis, intus longe (ad siccam) luteo-barbatis; staminibus subinclusis glabris; stylo versus basim attenuato; stigmate bipartito incluso.

Arbor 15-40-pedalis. *Foliorum* lamina 4-9 pollices longa, 2½-6 pollices lata. *Petioles* pollicem longi. *Panicula* 7-11 pollices longa, 6 pollices lata. *Rami* floriferi foliosi 6 poll. longi, bracteolati 3 pollices longi. *Corolla* 7 lineas longa.—*Klotzsch, Ueber die Abstammung der im Handel vorkommenden Rothen Chinarinde, in Abhandlungen der Königl. Akadem. der Wissenschaften zu Berlin, vol. for 1858, p. 60; Bonplandia, vol. vi. p. 388 (1858).*

This species, according to Pavon, produces the "*Cascarilla colorada*," or "*Red Bark*" of English commerce; terms which may be regarded as synonymous, as is apparent, in the first place, from the description of the bark itself, of its colour, and of its great use in medicine; next, we have the account in the 'Quinologia' of Ruiz of the "*Cascarilla colorada*," of its discovery and introduction into European commerce, which (conjoined with the mention of the places of its growth) manifestly shows that by the term "*Cascarilla colorada*" the Spanish traders and botanists meant the sort which in English commerce we call "*Red Bark*;" then follow the samples of *Cascarilla colorada de Huaranda* (the Red Bark of Guaranda), evidencing the identity of the Red Bark of commerce with that of

C. succirubra. These specimens are found in Pavon's collection as No. 21 in the British Museum, in the Royal Museum at Berlin, and in that of M. de Lessert at Paris, and that of Dr. Reichel, who most obligingly favoured me with a portion, also in that which I purchased from Madrid, in which this bark is well represented. Lastly, I have received from the place of growth specimens which fully confirm the views expressed above. I am indebted to G. C. Bruce, Esq., of London, one of the chief importers of commercial Red Bark, for his assistance in procuring these for me. They reached me in 1858, by way of Guayaquil, the usual port of export for this sort, in a box containing beautifully preserved leaves and flowers (but not fruit) from the western slopes of Chimborazo. Unfortunately, the botanist who procured them neglected to send with them portions of the bark of the same trees. These I expect to receive, but may have to wait long for the promised remittance, owing to the unsettled state of the country.

I have been thus particular in recapitulating the evidence that the *C. succirubra* produces the genuine "Red Bark," because in the sequel it will be seen that more is to be made out than at first appears in this *quæstio vexata* of Quinology. I will now describe the contents of my box of specimens, classifying them in the order most convenient for botanical information.

No. 1 is labelled,* "Inverse and obverse leaves of the *Cinchona roja*, taken from a tree on the slopes of Chimborazo to the west (in a forest called Linchy). Temperature, 21° centigrade. The temperature was taken by placing the thermometer in the ground to a depth of 1½ feet, and leaving it there for some hours." These leaves are faithfully represented in the portions† marked 2, and will be seen to correspond with those on the flowering branch (1) drawn by Mr. Fitch from a fine specimen at Madrid. They are broadly ovate, with sinuated margins, slightly acuminate, and attenuated near the petiole, the upper side smooth and of a deep green colour, the lower side slightly pubescent, especially along the course of the veins, and lighter in colour. The red colouring is given according to No. 3, which is described as "a leaf taken from No. 2 tree; when gathered is of a very bright red colour, which it will probably lose by drying; the leaves generally assume this colour before falling off." The colour is now a maroon-red. According to Karsten, this peculiarity of the reddening of the leaves in their decadence is shared by several *Cinchonæ*,—the *C. cordifolia*, *C. pubescens*, etc. Those of the *C. lancifolia* also redden, and become, when they fall off, an indication to the cascarillero of the vicinity of such trees. Those of the *C. Condaminea*, according to specimens in my possession, assume the same hue; but, as far as can be judged, none have so bright-red a tint as those of the *C. succirubra*. All my specimens of these last are eaten in places by the larva of some insect, just as I have seen such at work in the oak-leaves of our own country, feeding on the substance of the leaf, and leaving the cuticle on both sides almost intact, which thus shelters them during their depredations. The size of the largest leaf is seven and a half inches by five and a quarter. No. 2 consists of "leaves taken from a tree on the western slopes of Chimborazo, temp. 21° C. This tree is found growing with that called No. 1, the only difference being in the bark, which in this specimen is paler

* The original inscriptions are in Spanish, written in pencil on the blotting-paper to which the leaves are attached. The English translation was made by Mr. Bruce's correspondent at Guayaquil. The original is as follows:—No. 1. "Hojas del árbol de la Quina roja, tomados de un árbol á la temperatura de la estacion 21 grad. cent. de la montaña del Linchy."

† Drawn from the above leaves, and from No. 6, which is described as "leaves, *cogollo*, or heart, and undeveloped flowers of Red Bark."

in colour, and exceedingly resinous, as may be observed when the bark is dry, a circular resinous mark being formed.”* This is probably the “paler and more resinous” sort, described as “Quinquina rouge-pâle” by Delondre in his ‘Quinologie,’ p. 30, and represented in plate 8 of that work. The leaves accord entirely with those of the preceding, except in their being more rotundo-ovate. It must be a form, at most slightly varying, of the *C. succirubra*. I have felt more difficulty in arriving at any certain conclusion regarding No. 5, described as a “specimen gathered from a tree lower down than Nos. 1, 2, and 4. The bark of this tree is thick, and very resinous when fresh. The epidermis is apparently joined to the bark, forming one solid piece, the whole bearing a woody aspect.”† The one leaf of which this specimen consists is so peculiar, that I am inclined to believe it is either a new species, or a very distinct variety of the *C. succirubra*. The shape is regularly ovate, approaching nevertheless to oblong, and attenuated towards the petiole. The manner in which the nerves are set out from the central rib differs from what is seen in the normal *C. succirubra*, and, I think, greatly resembles Dr. Weddell’s specimen of his *C. ovata*, var. *erythroderma*. It corresponds almost entirely in the outline with the large single leaf of *C. ovata*, var. *rufinervis*, in tab. 12 of the ‘Histoire’ of this celebrated botanist, and I have no doubt that, as far as can be judged by one leaf, it is to the above-stated var. *erythroderma* that we must look for its nearest relationship. The only difference I notice is, that, according to my remembrance of Dr. Weddell’s specimen of the *C. erythroderma*, the latter possesses a much firmer texture than my leaf, which, on the contrary, is so completely membranaceous, and so smooth on both surfaces, that the only *Cinchonæ* I have seen to compare with it in these particulars are the *C. glomerata* of Pavon, and a specimen in my possession of *C. micrantha*, a. *rotundifolia*, Wedd., the produce of which I have mentioned under the head *C. micrantha*, as being a “spurious red bark.” In other respects it differs from both of these species, and on the whole I believe this will prove to be the Ecuadorian representative of the *C. erythroderma* of Bolivia.

But there is yet another subject for consideration in reference to certain specimens received in 1856 from the canton of Alausi. Of these, which were in an imperfect state of preservation, one, it will be seen by the following description, was considerably larger, but several smaller, than the leaf No. 5. The branch with these large and small leaves and with stipules, reproduces the *C. succirubra* of Pavon as represented in Mr. Fitch’s drawing, with a slight tendency to the No. 5 form in the more oblong-ovate form of the leaves, and some of the smaller leaves correspond very closely with the No. 5 or with the *C. erythroderma*.

I should have felt a difficulty in referring these various leaves to one source, but careful examination leads me to place confidence in the leaves having been all taken from the same tree, according to a statement accompanying the leaves in the box in which they were placed.‡ Pavon’s description

* “No. 2. Quina roja se encuentra á la misma altura que la anterior, y se diferencia en que la cortezon no es tan colorada y son mas resinosa.”

† “No. 5. Se tomó... mas bajo que la anterior. La corteza es gruesa y la epidermis mas adherida, bastante resinosa, y razada en la fractura interior. Viene tambien con las otras clases.”

‡ Apparently by the person under whose superintendence they were gathered, and in a different hand from the account sent from Guayaquil. It was as follows:—“Pertenece al mismo árbol, y fueron tomados en el mes de Septiembre de 1855. La Cascarillera empieza á florecer el en mes de Enero, per cujo no pueden mandarse flores.”

also confirms this view, as he remarks great variation in the leaves, and that of a similar character. The most probable supposition appears to be, that the normal *C. succirubra* (which is unquestionably the source of the brightest Red Bark) varies on the one side towards the “Quinquina rouge-pâle” variety, and on the other, through one or two intermediate shades, to the woody *C. erythroderma* of Bolivia.

I subjoin extracts from the account published by myself in 1856, comprising Dr. Weddell’s opinion as to the leaves last in question.*

“The specimen tree now described, and received in 1856, contained in two chests the following portions, viz. two pieces of the trunk, three of the large roots, five of the thickest branches, and one small box containing small boughs and leaves placed between paper. The leaves, though injured by imperfect drying, are still characteristic of the species. The collector apologized for not sending the flowers or fruit, because the time of year was not favourable. The tree was cut in September, 1855.† The account sent was as follows. After enumerating the parts above described, including also another portion mentioned as ‘the head of a tree, with small boughs and leaves,’ but which nearly perished on the way, he says:—

“‘All from the same tree of Red Bark (*Cascarilla roja*), cut in 2° 16’ south latitude and 16’ longitude west of the meridian of Quito, from a mountain called Chahuarpata, near the village of Cibambe, in the province of Alausi, one of the spots which produces the best Red Bark. There are not now large trees to be found, but only a little larger or less than the one sent, which is of middling size. Each piece has attached to it a paper, showing the part of the tree to which it belongs.’

“The trunk of the tree at the lowest part, from which the roots have been cut away, is not more than between two and three feet in circumference, and the branches are from about fourteen to eighteen inches of similar measure. The roots are of proportionate size. The thickness of the bark on branches of four and a half inches across is not more than one-tenth of an inch. The weight of the bark is about one-twentieth that of the wood. The very large and fine Red Bark sometimes seen, and commanding a price of seven or eight shillings per pound, must therefore be procured from trees of great age and size, and these no doubt fall quickly under the axe of the cascarillero, thus accounting for the scarcity of the finest samples. The age of the tree has also probably some influence in producing the light spongy texture of those specimens which have the highest colour. The bark varies much in different parts of the tree. That on the trunk, and even on the large roots, presents the familiar aspect of commercial Red Bark with the peculiar brick-red appearance, where the warty excrescences are rubbed or chafed. Near the roots the bark becomes thicker and more corky.

“The small branches present the silvery epidermis which we meet with in the small quills. That on the larger branches resembles exactly the stouter quills of Red Bark, and where the outer coat has exfoliated, the derm shows the small pock-marks, or indentations, which are characteristic of the best commercial quality; the different portions of the trunk and branches exhibit the variety of coating usually seen in commercial Red Bark of genuine quality. The Red Bark which came in the same

* See Pharm. Journ., vol. xi. p. 497.

† The *C. succirubra* flowers in July and August (see Pavon), commencing, according to my informant, in January (?).

ship, and, I think, from the same place, was of very good quality. I find the heart-wood of the tree to be rich in kinovic and less so in cincho-tannic acids, forming together rather more than two per cent. of the weight of the wood. It also contains much kinate of lime. The leaves yield a large quantity of chlorophyll, affording an alcoholic solution of a beautiful dark-green colour, rich purple by reflected light. Cincho-tannic acid appears to exist abundantly in the leaves, and (although a little altered in consequence of their imperfect drying) still precipitates salts of iron. The chlorophyll precipitates with salts of copper, and dissolves again unchanged in alcohol.

"The varying size and form of the leaves may be inferred from the woodcut* accompanying this description in the 'Pharmaceutical Journal.' The largest in my possession, a little imperfect at the apex, measures about nine inches in length by six in width.† The shape of the leaves is that of *Cinchona ovata*, approaching perhaps more nearly to the variety *a vulgaris* than to the var. *β rufinervis*, in which latter the leaf appears to be somewhat longer in proportion to its width. The Red Bark leaves, however, instead of being 'subcoriaceous' (as in the *a* variety, illustrated by specimens given me by Dr. Weddell), are 'submembranaceous,' thus confirming its connection with the variety *γ erythroderma*, the bark of which agrees very closely with the sort under consideration.

"Of this variety, Dr. Weddell says:‡—

"“I thought at one time that the “true Red Bark” ought also to be attributed to *Cinchona ovata*, but, in looking at the specimens which M. Guibourt has shown me, I have been obliged to suspend my judgment. The barks on which I founded this opinion were gathered in the valleys north of Cusco, and as the tree which produces them presents at the same time some differences in the leaves, I have made it into a separate variety, giving it the name *erythroderma*, which recalls its most interesting character.’

"This seems to have been a most felicitous designation, thus conferred by anticipation by this excellent botanist, who has done so much to illustrate the history of this invaluable genus. On the receipt of the above specimens, I wrote to Dr. Weddell, and also transmitted to him some of the leaves. He says (under date August 12th, 1856, having received them), ‘The leaves I find in a better state of preservation than I might have expected from your account. *They undoubtedly appear to correspond exactly to what you infer as to their botanical origin.*’

"Dr. Weddell further remarks in the 'Bulletin de la Société Botanique de France,' tome ii. p. 438:—

"“It seems to me now demonstrated that the tree to which I applied in my 'Histoire des Quinquinas' the name which I have mentioned, is really that which produces the officinal Red Bark. My hypothesis is confirmed by an interesting discovery made quite recently by Mr. Howard, in the herbarium of Sir W. J. Hooker. It is that of a flowering specimen of *Cinchona*, bearing, in the handwriting of Pavon, the provincial name which is now generally known to be that of “Red Bark,” *Cascarilla colorada de Huaranda*.

* *Vide* the 'Pharmaceutical Journal' for October, 1856.

† Exactly corresponding to the largest size indicated by Dr. Klotzsch. See his description.

‡ 'Histoire,' etc., p. 62.

“Mr. Howard having obligingly communicated to me the figure which he had caused to be drawn of this specimen, I had no difficulty in seeing in it the image of my *C. erythroderma*. It is true that the differences which I mentioned between the bark of my tree and that which is commonly met with in commerce exist still as before, but I have found *intermediate forms which so perfectly connect these two types*, that there no longer exists in my mind any doubt concerning their identity.

“There may be a doubt, on the contrary, as to the rank which should be attributed to the plant which produces them. Should it still be attached to *Cinchona ovata* as a variety, or should it be raised to the rank of a species? It is a point which can scarcely be finally decided until we know its fruits. Whatever it may be, the discovery made by our colleague Mr. Howard, of a flowering branch of the *Q. de Huaranda*, has certainly brought the problem very near to a solution, and has appeared to me worthy the attention of the Society.’

“I may add, in reference to the piece of the bark of *C. erythroderma* (*C. ovata*, var. γ *erythroderma*) given me by Dr. Weddell, that it agrees in several minute particulars with that of the commercial Red Bark. The colour of the denuded derm, the indentations upon this, and the impression of a cross crack, forming a ring at distant intervals, also the character of the periderm,—all these correspond; but the colour is not fully equal to that of the *finest* Red Bark, and it is perhaps rather more dense and woody; but even the bark of the branch and trunk of the same tree vary in these particulars.

“The Huaranda bark in the British Museum, which both M. Guibourt and myself regard, and which I described in the ‘Pharmaceutical Journal,’ in 1855 (vol. xi. p. 497), as genuine ‘Red Bark,’ has also peculiarities such as might mark a tree grown in a less favourable soil. The leaves and small branches of my Red Bark tree give the impression of luxuriant vegetation. That of Pavon’s specimen, on the contrary, tells of rather stunted growth. But such variations must be expected in a tree growing in localities so distant from one another.

“The last particular which appears to me confirmatory of the correctness of this botanical derivation, is the very close analogy which exists between the ‘Red Bark’ and that which is called in commerce ‘Carabaya Bark,’ and which, according to Dr. Weddell, also proceeds from a variety of *C. ovata*. This struck me long ago, and would occur to any person who will take the trouble to compare the two sorts; but it is not a matter susceptible of demonstration, and I will not dwell upon it.

“It is to be hoped that the remaining links of this chain of investigation will shortly be added, through our being put into possession of the flowers and fruit, as well as a further supply of the leaves of this interesting tree; and that these will afford materials for completely determining whether it coincides with Dr. Weddell’s *Cinchona ovata*, var. γ *erythroderma*; and whether, if such be the case, that plant ought to be raised to the rank of a species.”

Such was the amount of information gathered in 1856. Since then we have not only the specimens to which I have referred as sent me in 1858, but also a very valuable Memoir* on the Derivation of the Red Bark of commerce, published by Dr. Klotzsch in 1858, to which I shall have further occasion to refer, especially in reference to the microscopical observations therein contained.

* Read on the 17th of December, 1857, before the Berlin Academy.

This eminent botanist, having the advantage of examining an excellent specimen* of this species, which he showed me in the Museum at Berlin, was the first to publish a description of the *C. succirubra* in the accurate diagnosis of which I have now given the reader the benefit. Dr. Klotzsch refers to the particulars I have already given, and to his intercourse on the subject with me, and endeavours to throw light upon the question whether the *C. succirubra* was to be considered a variety of *C. ovata*, or a distinct species. He then gives it as his opinion (p. 60) that Dr. Weddell would have done better to have constituted the varieties of *C. ovata* distinct species. In this I fully concur, and also in the conclusion to which Dr. Klotzsch arrives, that the *C. succirubra*, Pavon, has no nearer relationship to the *C. ovata* of Ruiz and Pavon than to all the remaining members of the family of Cinchona.

This species appears to be an exception to the rules laid down by Karsten as to the area of growth, and the climate which he esteems necessary (and, no doubt, rightly so in the *Cinchonæ* which have fallen under his observation) to the production of the finer sorts of bark. This he places above the region of intermittent vegetation in which the *Ladenbergiæ* and the *Cascarillos bobos* flourish, in the cooler atmosphere of mountain ravines almost continually wetted, through the condensation, by cold winds from the summits, of the humid strata of air ascending from the warm valleys. Here, on the other hand, we have a Cinchona which certainly deserves to rank amongst the very richest in its varied and peculiar products, which yet flourishes in wooded regions where the mean temperature, according to my informant, rises above that which is congenial to the finest sorts.

I must, however, admit, that his mode of ascertaining the mean temperature appears to me calculated to give rather too high an average; and this suspicion is confirmed by reference to Don M. Villavicencio, who gives the mean temperature of Guaranda at 15°, that of Alausi 15°, but yet with a somewhat harsh (*triste*) atmosphere, that of Cuença 15° 6', and that of Riobamba 16° 4'. The average of all these stations is 15° 5' Centigrade, or as nearly as possible 60° Fahrenheit, whilst Humboldt† says of the *C. Condaminea*, that it is exposed to a mean temperature of from 15° to 16° Réaumur, which is about the mean warmth of the Canary Islands, and from 5° to 6° Fahrenheit higher than that required by the *C. succirubra*.

On the whole, I conclude that this last-named species flourishes indeed in cool situations ("locis frigidis," Pavon), but within the region of intermittent vegetation, especially as the anatomical examination of the specimen tree which I received discloses the fact that this was cut just at a period when "no formation of wood or bark was going on," and (as the reader will find further on) this was in the month of September, after the flowering season had passed over. Ruiz informs us that "it was first discovered in the woods of Riobamba, Cuença, and Jaen, in situations cold at night, and warmed by the sun through the day, and in soils entirely analogous to those in which the other fine barks are produced."‡

The following description, by Boussingault, of the climate of Riobamba, will therefore illustrate the

* With the inscription, "C. succirubra. E Cuença y de los Cerros de S. Antonio, camino para Huaranda, en la provincia de Quito."

† Lambert's 'Illustrations,' p. 56.

‡ The soil about Guaranda is (according to Villavicencio) micaceous schist; that of Alausi, porphyritic syenite. Cuença is situated in a beautiful plain, with a soil of ferruginous sand, at an altitude of 3,032 varas (8,420 feet) above the sea. Guaranda is 1° 34' S. latitude; Alausi 2° 16'; Cuença 2° 57' S. Lat.

requirements of the vegetation of the species, and these details may not be without their use in connection with the present attempt to localize the *Cinchonæ* in mountain ranges in India.* “Riobamba itself is situated in an arid plane, surrounded by a grand amphitheatre of snow-clad mountains, amongst which the names of Tunguragua and Chimborazo are most familiar to Europeans. This vast amphitheatre of snows, which circumscribes the horizon of Riobamba, offers continual opportunity for the most varied observations. It is curious to notice the aspect of those snowy summits at different hours of the day, and to see their apparent height vary from one moment to another through the atmospheric refractions. With what interest do we not observe, in so limited a space, the production of all the grand phenomena of meteorology! Here an immense horizontal cloud, of those which De Saussure has defined with so much exactness under the name of Parasites, girds the middle of one of those elevated trachyte cones, and keeps its position without dispersing through the violence of the winds. In a little time the lightning darts from this mass of vapour, the hail and rain inundate the base of the mountain, whilst the snowy summit, inaccessible to the tempest, is illuminated by the sun. In another part is seen a cupola resplendent with ice, whose projection on the deep azure of heaven permits us to distinguish its most delicate outlines. The atmosphere appears pure, transparent as the most diaphanous crystal, when, beholding attentively, we suddenly perceive that this snowy peak is becoming covered with a cloud in the form of a light veil, which seems to emanate from its bosom, as if it discharged smoke. This cloud has not completed its formation when it disappears, to reproduce itself immediately, and again to vanish. Such an intermittent formation of cloud is a phenomenon very frequent in the snowy sierras, and is particularly observed in the fine season, and always some hours after the culmination of the sun. In these circumstances the snowy mountains may be compared to condensers, elevated towards the higher regions of the atmosphere, to renew freshness and dryness to the air, and thus in this manner is restored to the superficies of the earth the water which had been diffused through the atmosphere in the form of vapours.

“These plains, surrounded by snowy mountains, present the most lugubrious aspect when a constant wind brings moist air from the warm region. Then the mountains cease to be visible, and the horizon is covered with clouds, which appear to touch the earth. The weather continues cold and damp, since the rays of the sun cannot penetrate the thick mass of vapours, so that there is nothing but a continuous twilight, the only one which is known in the tropics, since in the equatorial region night succeeds suddenly to day, and the sun appears to be extinguished in its setting.”

It cannot be difficult to meet with a similar climate to the above in the mountain ranges of India, to which it is much to be desired that this species could be transferred.

It is probable that the true *C. succirubra* is becoming scarce, as in consequence of its producing the richest coloured bark, it will be most sought after by the cascarilleros. I have seen strong statements, in letters from Guayaquil, as to the increasing difficulty of procuring the fine qualities, but these are scarcely borne out by any corresponding decrease in the importations. Some is now brought from Cuença, which is reckoned of inferior quality, and as this inferiority simply relates to the brightness of the colour, the opinion may be correct. In the quantity of alkaloids contained, a specimen

* ‘Geografia del Ecuador,’ p. 321.

which I have just examined from Cuenca gives a product equal to that from the former localities.* I doubt if it is possible now to meet with such fine and large Red Bark as the dealers speak of having seen in old times. Very large pieces occur, but these are generally of the more woody variety. I have one beautiful quill from Pavon's collection, of a richer colour than I can now find (as *quill* bark) in any modern importations.

The western slopes of Chimborazo, between Chillanes and Guaranda (Huaranda), including the village of San Antonio,† have been indicated by Dr. Weddell as those in which this precious product of the forest were chiefly sought; and if fresh localities are found, not only at Cuenca and Jaen, but even further south,‡ still it is most probable that it will prove rather to be the inferior varieties which occupy these regions than the normal *C. succirubra*. It is possible that this may even in a short time become extinct as an article of commerce, existing only in some scattered specimens in the midst of the tangled woods where, as overspread with epiphytical vegetation, it may escape the keen eye and the axe of the cascarillero. My specimens from the slopes of Chimborazo exhibit the character of the plants, which find their congenial abode, whether in twining as lianas around, or as mosses§ in still more intimate connection with the trees in question. No. 7 of the before-mentioned specimens is marked, "Parasite plants growing on the trunk and branches of the tree. The centre leaf is the Guaco,|| the famous Indian specific against snake-bites" (this appears to be the *Aristolochia fragrantissima* of Lambert's 'Illustrations,' p. 176, plate, *l.c.*). "The vine round the (centre) leaf grows in large quantities on all the trees in the Bark mountains: but when found on the Bark trees it has been known to give, on analysis, a small quantity of Quinine." This resembles the *Marcgravia umbellata* or *picta*.

The commercial history of Red Bark is not without interest, although involved in some obscurity.** It is uncertain at what period it first made its appearance in commerce. Dr. Fothergill, in a letter to

* Or 3.54 per cent. of Quinine, Cinchonidine, and Cinchonine, also Aricine.

† This is given as a site, not only by Pavon, but also, in 1858, by Don M. Villavicencio, who says:—"The villages of San Antonio and Chillanes are situated in the wooded regions beyond the Cordillera, and in the hills on the sides of this are found woods (*bosques*) of Red Bark of great value" (Geografia del Ecuador, 1859).

All the places named (except Jaen) are comprised within a circuit of about eighty miles in diameter. Linchy is not far from Sibambe, in the canton of Alausi. San Antonio and Chillanes are in the canton of Guaranda. All the above are included in the province of Chimborazo. See the 'Carta Geografica' of Don M. Villavicencio.

‡ Amongst Pavon's specimens of sections of branches, there is one marked as "a distinct species of Red Bark," No. 35, which appears to me agree with the tree which I received in 1856. It is probable that the above section was from a tree found not far from the neighbourhood of Loja.

§ The specimen of moss was apparently an undefined species of *Bryum*, which I gave shortly before his lamented death to Robert Brown, Esq.

|| Described by Ruiz as *Aristolochia fragrantissima*, and called Bejuco de la Estrella, or Contrayerba de Bejuco, that is, the Bejuco, or climber, possessing the properties of a *contrayerba*, or *counter-herb*, i.e. antidote (Lambert, Illus., pp. 149-176). The leaves sent to me appear to coincide with both the description and the plate. The account given me of this plant by M. Cordova, of Monte Christi, Ecuador, is, that there are two sorts, one with white, the other with purple leaves. The report in the country is, that the Indians learnt the use of the herb from a bird called Guaco, which feeds on serpents, and when accidentally wounded, resorts to this antidote, which is thence called by the same name as the bird. For the account of other plants having the same Indian name of *Guaco*, on account of similar properties, see Humboldt in Lambert Illus., p. 21, 'Noticias Secretas de America, por Don George Juan,' etc., p. 571, and 'The Botany of the Voyage of H.M.S. Herald, by Dr. Seemann,' etc., *sub voc.* Mikania, p. 150, also for the *Aristolochia* 'Redwood's Supplement to the Pharmacopœia,' pp. 469, 470.

** Bergen, in his 'Monographie der China' (pp. 270, 271), gives strong reasons for supposing that occasional parcels may have previously found their way to Europe. On the other hand, Humboldt says that "from 1638 to 1776 no other Cinchona Bark was known in commerce except that of Loja and its neighbourhood" (Lambert, Illus., p. 24).

Dr. Saunders, traces this to the beginning of the eighteenth century. Ruiz was informed,* that “in the years 1785 and 1786 (?) one and another cascarillero began to gather the barks of these trees, which were sold for a low price at Guayaquil. The first merchants who bought these barks sent them to Lima, although fearing they might be rejected by their correspondents there. As these latter had no knowledge of such a kind of bark, and did not know how to distinguish its qualities, they sent to Cadiz some chests, by way of sample, and the English merchants paid at the rate of sixty reals vellon (equal to three dollars, or three ounces of silver) for every pound of this bark. When this was reported at Lima and Guayaquil, the merchants resolved to send a greater number of chests, and the cascarilleros addressed themselves to cutting greater quantities of this bark, which continued to sell in Cadiz with as much estimation as the best Loja bark.” There is some discrepancy between this account and that of Dr. William Saunders, senior physician of Guy’s Hospital, whose elaborate and able work tended greatly to introduce this sort of bark to the favour of the medical profession. “The introduction of the Red Bark into this country,” he tells us,† “was the effect of chance. In the year 1779 a Spanish ship from Lima, bound to Cadiz, was taken by the Hussar frigate and carried into Lisbon; her cargo consisted chiefly of this bark, some part of which was immediately imported into this country, and a considerable quantity was bought at a very low price at Ostend, by some of our London druggists. The boxes in which it was brought to Europe were of the same kind as those in which the common Peruvian Bark was contained, and all sold by the general title of Quinquina. The druggists in whose hands the Red Bark at first was, found it difficult to dispose of it, its appearance was so very unlike that of common bark; at last they offered it by way of trial to such apothecaries as reside in countries where agues are frequent; the success attending its use soon convinced them of its superior efficacy. It was early introduced into the hospitals, and its greater powers became universally acknowledged.” A correspondence between Sir Joseph Banks and Professor Ortega‡ informed the latter of the superior results obtained in England with this sort, and the Red Bark came gradually to be preferred, even by some Spanish physicians, to other species,§ so that ultimately it will appear to have been substituted at the Spanish Court, wholly or in part, for the original *Cascarilla Colorada del Rey*, the celebrated bark of Loja.

In process of time it happened with this precious drug, as with so many others, that the high price gave occasion to the introduction of spurious imitations, going so far as the preparation of barks of other trees dyed red, or even, as in a specimen in my possession,|| coloured by means of red-lead.

A more mischievous, because more extensive and permanent substitution, was brought about through the means of Don José Celestino Mutis, of Santa Fé, in New Granada, between whom and the Spanish botanists of Peru a rivalry had sprung up, connected in part with the commercial interests of both countries, and leading on both sides into mistakes of greater or less magnitude. It is, I believe, universally admitted that no genuine Red Bark is found in the province of Santa Fé, but as Mutis was determined that in this as well as in the possession of the supposed “Quina primitiva” his adopted country should rival the provinces of Peru, he introduced into notice, and into the European

* See the ‘Quinologia’ of Ruiz, p. 86. The dates given to Ruiz are evidently erroneous.

† Observations on the Superior Efficacy of the Red Peruvian Bark, by W. Saunders, M.D., 1782, p. 19.

§ ‘Bull. de Pharmacie,’ tome ii. p. 304.

‡ Ruiz, ‘Quinologia,’ p. 86.

|| This specimen was given me by M. Batka: it was found in commerce on the Continent.

market, the bark of his *Cinchona oblongifolia*, similar to the *Cinchona magnifolia* of Pavon, and of which the reader will find an account under this latter head. This Red Bark of Mutis having thus become current, together with the description of the *Cinchona oblongifolia* as its origin, was the occasion of the widely-spread and permanent botanical mistake found in all the Pharmacopœias, which attribute the genuine Red Bark to this entirely worthless plant, that does not even belong to the genus of the *Cinchonæ*.

The above course of falsification proceeded until, in the year 1794, Dr. Relph complains* that “the true Red Bark so fully described and recommended by my learned friend Dr. Saunders, has all been consumed some time ago, and notwithstanding the increased demand for this species, the drug-merchants found it impossible to procure of it a second importation of the same quality; and though much bark is still sold under this name, yet upon examination it is found evidently inferior to the original Red Bark.”

It will assist in the explanation of the history of Red Bark if I reproduce here the following observations on the colours of barks.†

“The botanists of New Granada (Mutis and Zea) distinguished their four species by the names *orange-coloured*, *yellow*, *red*, and *white*, in imitation partly of the previously known barks of Peru. But it so happens, that the *yellow* of Santa Fé is not at all the *yellow* of Peru, and if possible, even less is it the “yellow bark” of British commerce. The *red* designation was equally unfortunate as to its identification with the *red bark* of Peruvian commerce, for the *purple-red* *C. oblongifolia* of Santa Fé had before obtained the appellation of *yellow* from the Peruvian botanists. The *white* was the only one which partially coincided in New Granada and in Peru, and this is no genuine bark at all, but the worthless *Ladenbergia* or *Cascarilla macrocarpa*.

“The confusion thus introduced has been perpetuated, and because the *yellow bark* of Mutis was the produce of *C. cordifolia*, therefore the *yellow bark* of commerce‡ was supposed to be *cordifolia bark*; and since the *red bark* of Mutis was the product of *Cinchona oblongifolia*, Mutis, the *red bark* of commerce was named in error *oblongifolia* also. “I conclude that the authority of a great *name* (that of Mutis) first gave currency to these errors, but perhaps something was owing to the more *intelligible* character of the distinctions which he established.

“These botanists of Santa Fé named their barks from *the colour of the substance of the bark as shown in the powder*, and this feature is easily noticed by any observer.

“But this was not by any means the case with the botanists of Peru, who indeed only followed the law of *custom*, which had previously established other marks of designation. Thus the distinction first made between *red* (*colorada*) and *yellow* (*amarilla*) in the king’s barks of Loxa, was, to common observers, a distinction almost without a difference, and, probably, simply the result of the *macho* and *hembra* varieties of the same tree. Then they had also two or three other *yellow* barks which were not *king’s* barks, the spurious *yellow* mentioned above (from their *Cinchona magnifolia*), the *yellow* of Chito (from *C. lutea*), and the *yellow* of Loja (from *C. macrocalyx*), besides the *yellow* of Cuença,

* ‘An Inquiry into the Medical Efficacy of a new species of Peruvian Bark (*the Calisaya*), lately imported into this country under the name of Yellow Bark,’ by John Relph, M.D., 1794, p. 74.

† First published in my ‘Examination of Pavon’s Collection of Peruvian Barks,’ in the ‘Pharmaceutical Journal,’ 1852.

‡ The produce of *Cinchona Calisaya*.

the product (according to Weddell, Hist. p. 74 and 72) of *Lasionema Humboldtianum*. It is pretty clear that none of these barks would have been named by the Santa Fé botanists *yellow*, and those which they *would* have called yellow (following the colour of the *substance*) were quite otherwise designated.* It will be observed that the Peruvian botanists had *several* red barks in addition to the *king's* red. Now, as the *king's yellow* and *red* had the prestige of celebrity in Spain, it was necessary for Mutis to produce *yellow* and *red* bark fit for the King, from New Granada, and he accordingly named the *oblongifolia* bark, *red* (roja), though otherwise he would have given it a more appropriate appellation.

"Then the 'grey bark' of commerce, if named according to the system of Mutis, would certainly have been the 'cinnamon-coloured bark;' for Ruiz and Pavon say (in their 'Suplemento,' p. 47,) the barks of *nitida* have a red colour like cinnamon, and assert that all the barks coming from Loxa, valued for royal use, including of course the red and yellow king's barks, had this peculiar colour of the substance.† The best portion of that which we now call 'grey bark' is called by M. Guibourt 'Red Bark of Lima.'

"Moreover, our term 'grey,' as given to the bark on account of the crustaceous lichens which cover it, is but an imperfect translation of the Spanish *Quina cana*, which implies the aspect of a head silvered over with age, *white* rather than *grey*.

"The term *pale bark* coincides with the Spanish *cascarillo palido*, but the precise meaning of 'palido' seems to be *yellowish-white*, which is correct as to the produce of *C. ovata*, but *in another and quite different sense*, which is explained by these botanists themselves. Thus Don H. Ruiz says:—

"The external colours of the *Cinchonæ* are not accidental. In these, as in all other trees, there are commonly external colours, one natural and proper to each species, and *different from that which proceeds from the lichens* or small cryptogamous plants which grow on its trunks and boughs, and cause those patches with which the natural colours are varied, as is seen in the *Populus alba*, or white Poplar, in the *Populus tremula* or Aspen, and in the *Populus nigra*, or black Poplar, in the *Ulmus campestris*, or common Elm, and in the *Ulmus pumila*. And though the natural colour may vary somewhat by reason of soil and climate, this will only be into a more or less lively shade, or in being spotted with a variety of lichens, so that, notwithstanding these accidental circumstances, the botanist, or even the most rustic labourer, may learn to distinguish the species of tree, as the white or black Poplar. The *Quinas finas* of Loja, and the other Peruvian sorts, have always presented *the same external colour*, although spotted with various lichens.

"According to this incontrovertible principle, *the external colours of the barks* of the Cinchonas, although not sufficient by themselves, are not, on the other hand, of so little importance as Dr. Mutis and yourself (Zea) have imagined. Our barks, as well as those of Santa Fé, not only differ from each

* "The barks of *nitida* have a red colour like cinnamon, a bitter more grateful than that of the *lanceolata*, and not so pungent. The internal colour of the *lanceolata* is a *clear buff*, *golden yellow*. (Suplemento, p. 47.)

"This bark, very similar to the *orange-coloured* of Mutis, was named '*lampigna*,' or '*glabra*' (*smooth*), from its outer surface."

† "The *Quina naranjada* of Santa Fé neither is nor can be the *primitiva*, since all the authors of the first times *attribute to it* (the *primitiva*) *the red colour of cinnamon*; and, without intermission, bark of this colour, as of superior quality, has been sent from Loja to the Royal Pharmacy, and *there is no account that they ever made use of any of the colour of orange, nor of any other yellow more or less deep*." (Suplemento, p. 112.)

other by the internal colours, but by the external, and by the remaining marks or characters, which present notable differences' (Suplemento, p. 58).

"It must therefore be borne in mind, that bark may be named either from the colour which its *powder* makes, which is the method of Mutis and Zea, or from the external peculiar tint of *the coat*, which is that of Ruiz and Pavon, or from the accidental adhesion of white or black *lichens*, a practice which custom has established. The method of the botanists of Santa Fé, though open to objection, merits this preference over the second, that it is capable of being generally appreciated, whilst the second is certainly not thus *obvious*, though I believe very *correct*. The third method is altogether deceptive.

"There are two more circumstances to be borne in mind in reference to the designation of barks by their colour. The first is, that the tints are sometimes not *absolute*, but simply *relative*, as in the case of the *black* (zamba and negra), *yellow* (naranjada and amarilla), and *white* (blanca and pallida) kinds of Calisaya bark. The second is, that the vernacular name is sometimes given from the tint of the tree ('Histoire,' etc., p. 51), as in *Calisaya verde*, *morada*, and *zamba morada*. This remark belongs of course only to the *country* names, and not to those of English commerce. It so happens, however, that the prevailing tint of the tree, as displayed in the flower and leaves, is often traceable also in the bark, and I have seen it curiously reproduced in analysis." (Also, as I may now (1859) add, in the living plant, as the *C. Uritusinga*, the source of very black bark, (called *Sambo Pongo* apparently from this circumstance), shows in young plants raised from seeds, a rich maroon tint on the stem and nerves of the leaves, instead of a roseate hue, as in the kindred *Colorada del Rey*.) "It is therefore not surprising that we find in the *Calisaya morada* a strong tendency to the 'mulberry-purple,' and in the *Calisaya verde*, to glaucous-green."

Ruiz remarks in his 'Quinologia,'* that "the colours of *purple*, *roseate*, and *red*, are common to all the species of bark; the purple and the rosy are found frequently in the veins and petioles of the leaves, in the [calyx,] flowers, and capsules; the red is peculiar to the inner portion of the barks. From the existence of these colours in a more or less bright or lively tone in the barks, it may be inferred that they all participate in citric acid in greater or less abundance."

This observation is very correct, if we only substitute the word "cincho-tannic" for "citric," since chemists had not then discovered the difference, nor assigned the new designation to this peculiar but newly-found acid. I have myself ascertained that by taking this resinous substance as it exists in the heartwood of the Red Bark tree, and as separated by the ether process, it is easy to produce the above varied colours in perfection. As it is found in the wood, this substance is of a light-yellow colour, almost transparent, but as modified under the influence of alkaloids or alkalis, it yields beautiful colours; and the Cinchona-red, its product, gives when sublimed a splendid purple vapour, which has recently been proposed by Grahe as a test for the presence of the alkaloids in bark.†

I have therefore little doubt that from this source are derived the various colours enumerated as found in the *Cinchonæ*. Querci-tannic acid can also be made to produce some very bright colours, though on the whole widely differing from those resulting from the cincho-tannic. The rufi-gallic

* Page 84.

† Centralblatt, 1858, No. 97; but see, *post*, note on p. 22.

acid is particularly remarkable, when first formed, as a gorgeous purple, but when separated it becomes a rusty brown-red, akin to that characteristic of the oak bark from which it is derived, when this has been bruised and exposed to the air. So in the Red Bark it is to be remarked that the brick-red colour which, as Ruiz observes, is not found in the growing plant, but in the dried bark, is really an excretory product of vegetation, a part used up and brought by contact with the air into a state in which it can no longer be serviceable to the living plant, and from which it degenerates by a still further degradation into *humus*, as we have reason to conclude, both from following out the above experiments on the changes of colours to their last result, and from observing analogous changes in the bark itself as it verges towards its latest stage. The pieces of flat Red Bark possessing the finest colour are generally remarkable for their specific lightness, having a texture analogous to that of wood that has lost its firmness by incipient decay. Indeed it is by a process of *eremacausis* that the Red Bark acquires its colour, the cinchotannic acid in which it abounds having become oxidized and changed into Cinchona-red; and under these conditions the alkaloids also appear to undergo some corresponding alterations. They are now implicated with resin, which appears to have also become oxidized so as to act the part of an acid, and is with difficulty separated;* the chlorophyll has disappeared; kinovic acid is still present; gum, which contributed to the so-called "resinous" character, and was abundant in the bark of the smaller branches, has undergone a decrease. But the most remarkable feature is the altered condition of the alkaloids themselves. Quinine, which formed a considerable portion of the whole, is now greatly diminished, cinchonine and cinchonidine remaining much the same. The total percentage has undergone no diminution, but rather the contrary, and an alkaloid, Quinicine (?),† which was either entirely absent from the smaller quills or present in a feeble proportion, now appears in a notable quantity. This does not appear to be the peculiar feature of any one variety alone, but to belong alike to all the thick pieces of old Red Bark. That which most answers to the description of the No. 5 variety comes occasionally in pieces, some quite flat, some partly curved, and two feet long by six inches wide, and from half an inch to an inch in thickness. These must belong to very large old trees; and to this kind of bark, which is of a bright brick-red colour when cut, the above observations apply very specially. The microscopical structure is altogether as described by Dr. Schacht in the anatomical examination which follows.

It must be an important question for the physician to decide, whether the large percentage, from 12 to 15 per cent., of colouring matter, of complex chemical constitution, produces a good or bad result when received into the stomach of the patient. I am not aware that we have any reliable information as to the medicinal effect of cincho-tannic acid and cinchona-red. For my own part I cannot suppose that the effect of the astringent principle of the Cinchona can be very different from that of the oak, or that the benefit resulting from the cinchona-red (apart from the alkaloids) can be much greater than that of an equal quantity of powdered oak-bark.

It is, in all probability, the large proportion of alkaloids entering into the total of its constituent

* This resin can be combined directly with Quinine. It then dissolves in dilute acids, in a brownish solution, which precipitates with alkalis in a dark-coloured mass, forming, when again combined with acid, brown crystals, separating with some difficulty from a solution of similar colour.

† Also Aricine (?); or perhaps the Quinio (?) of Batka. Centralblatt, 1859, No. 58.

parts which gave so great a currency to this sort, and caused it to be so much sought after, so that if the alkaloids alone had been administered, the antifebrile effects would have been equal, or perhaps, through the abstraction of the remaining heterogeneous matter, even increased. Resin is present in a pure state, but in minute quantity, in the small quills; and kinate of lime and kinovic acids are found, moderately abundant, in both the large and small barks.

The characteristic peculiarity of Red Bark is that it ordinarily contains, and that quite irrespective of the brightness of the colour, a much larger proportion of alkaloid than most other kinds,* amounting to as much as three to four per cent. of the substance of the bark, and this divided amongst the alkaloids Quinine, Cinchonine, Cinchonidine, Quinicine?, and Aricine (?). I have found Quinidine (Pasteur) chiefly in one sample "from a new district."

An importation has just taken place, *via* Guayaquil, of genuine Red Bark, in large pieces, distinguished by a deep, in some cases, purple-red colour. Some of the pieces are remarkable for their great specific gravity. In this bark, notwithstanding its weight, the oxidizing process seems to have proceeded to a great extent. Quinine and Cinchonine have nearly disappeared; kinovic acid is in small quantity; but gum is abundant, and the resin-combination of the alkaloids has assumed a marked prominence, and gives the character to the bark, which in other respects must be noted as not containing more than 1.80 per cent., or half the amount of alkaloid found in the sorts previously described.

This sort corresponds with the quill from Pavon's collection mentioned above, which is marked (erroneously), in Pavon's own writing, as *Quina roxa* ("roza," Schleiden) *de Mutis*, and which, judging from a similar specimen, Professor Schleiden rightly ascribes to a genuine Cinchona.† It is probably a resinous sort of *C. succirubra*. The trees must have been very large, as some of the bark is an inch in thickness.

In reference to the *Anatomical Examination* of this species, I have great pleasure in placing before the reader the materials afforded in the before-mentioned publication on the origin of Red Bark. Dr. Klotzsch availed himself of the very able assistance of Dr. Schacht, who subjected to careful microscopical investigation the following materials:—

1. The lower part of the twig of the flowering specimen of *C. succirubra*, Pavon, found as before-stated in the Herbarium at Berlin.
2. Commercial Red Bark from the canton of Alausi, of different sizes, which I had given to Dr. Klotzsch. This was apparently the *succirubra* sort. It came with my specimen tree in 1856, from the same district, and I have mentioned it as yielding me between three and four per centum of alkaloids.
3. A section of the specimen tree itself which I gave Dr. Klotzsch.
4. The bark of *C. lucumæfolia*.
5. The bark of *C. micrantha*, var. *a. oblongifolia*, Wedd.? Both these last given as above.

* The finest sample in my possession, of the best quality of *C. succirubra* (bright-red throughout), is of a parcel imported in 1850, containing 3.91 per cent. of alkaloids, which sold for 8s. 9d. per lb. The quill of this same parcel yielded me 3.6 per cent. of alkaloids. This sort is represented by Bergen in his *Monographie der China*, pl. 1. fig. 5, 7, 8, 9.

† *Handbuch der Botanischen Pharmacognosie*, p. 259, note.

After describing various general particulars in reference to the anatomical examination of the bark, from Schleiden, and the difference of his own terms of definition, etc., Dr. Schacht gives us the following examinations.

No. I.—RED BARK OF COMMERCE.

From thick branches, covered with thick bark, but in part exfoliated, half-flat pieces, 9 to 15 millimetres wide, the layer of bark in which amounts to only 5–6 millimetres. The outer surface of the dusky dark-brown bark, which is here and there brighter or redder, is irregularly cleft with long furrows and long wrinkles, from which frequently long, round, corky warts protrude. Besides these, at about an inch apart, deep but not gaping cross-cracks make their appearance. The fracture of the inner bark is fine-splintery. The thick layer of bark shows here and there, when cut across, band-like pencillings. The inner surface is clear red-brown and long fibrous.

Anatomical Examination.—The thick cork layer is not everywhere stratified, but only here and there; bands of cork also intrude on the outer portion of the primary bark, so that a true periderm is the result. The primary barks, so long as these have not become periderm, consist of tangentially arranged parenchyma-cells, with porous, clear, brown-coloured walls. Crystal cells are rare; Schleiden's resin-cells (thick-walled parenchyma-cells, filled with a brown resinous substance) and lactiferous vessels (Schleiden's *Milchsaftzellen*, very broad, thin-walled cells, occurring ordinarily at the limit between primary and secondary bark) are likewise entirely wanting. The primary bark verges in an almost imperceptible manner into the secondary, where, between the radial rows, which are formed out of woody fibre and an irregular small-celled parenchyma, three- to four-celled radial rows of tangentially-arranged parenchyma-cells run, which answer to the medullary rays. In the younger innermost part of the bark these medullary rays become narrower, since their cells, no longer tangentially arranged, but universally becoming smaller, appear quadrate, and at last entirely radially placed. In the youngest part of the bark, which Schleiden calls *Bastschicht*, the medullary rays are the plainest: they consist of three to four cell-rows. The already formed woody fibres lie in radial rows; small, long-strewn, and thickened cells, like the *Bastzellen*, woody fibres, which Schleiden calls *Faserzellen*, occur like the crystal cells, but particularly seldom. In the tangential cut the medullary rays appear singularly short: in the middle short, but on both sides ending in a point.

No. II.—RED BARK OF TRADE, STEM AND ROOTS OF *C. SUCCIRUBRA*, Pavon, 1856.

For the most part, half-flat, partly half-quilled pieces, 6–10 millimetres thick, covered, like the former number, with strong outer bark. The cork particularly like that of the former number, but for the most part without cross-cracks, and here and there with a white coating of lichens. The fracture of the inner bark is fine-splintery; the inner side of the bark just as in the former number.

Anatomical Examination.—The cork, arranged in layers, is partly advanced in the form of bands to the thick old pieces of stem-bark, even to the limits of the primary bark, through which this last is changed into outer coats and in portions thrown off. In the older secondary bark, the order of the parenchyma-cells is less regular than in the former number; on the other hand, the younger secondary bark answers fully to the former: the medullary rays are three- to five-twisted, the already formed woody fibres, beside which, only here and there, less perfectly formed woody fibres (Schleiden's

Faserzellen) appear, lie in long rows. Crystal cells are more frequent than in No. 1; the tangential cut quite as there seen. *Resin-cells and lactiferous vessels are wanting.* A comparative anatomical examination of the different pieces belonging to this number gives unfortunately no sure mark of distinction for the bark of the root, which is not specially distinguished. There seems to obtain no particular difference between it and the bark of the stem.

No. III.—RED BARK OF TRADE, FROM THE TWIGS OF *CINCHONA SUCCIRUBRA*, Pavon, 1856.

Weak, and for the most part quill-formed pieces, $1\frac{1}{2}$ to 3 millimetres thick, with tender cork, which is clothed here and there with a white covering of lichens. The general colouring of the bark less red than in the former numbers. The outer surface smooth, and almost without prominent corky warts; cross-cracks more rare; the fracture of the inner bark fine, splintery. The inner side coloured clear red-brown, and long fibrous.

Anatomical Constitution.—The cork, arranged in layers, does not penetrate the primary bark, which, as in No. 1, consists of tangentially arranged parenchyma-cells, with porous walls: resinous and lactiferous vessels are wanting as there; the transition to the secondary bark is also here quite universal in the thicker pieces. The very beautifully formed woody fibres appear in radial long rows, and in some places of the same section more richly, in others more sparingly; beside these, Schleiden's *Faserzellen* make their appearance. The medullary rays are in three to five rows on the tangential cut, as on Nos. 1 and 2. On the other hand, the crystal cells appear in these younger barks more frequently than in the former numbers.

No. IV.—SECTION OF THE SPECIMEN TREE.

The section of a branch, 17 centimetres in diameter, whose bark is not more than $1\frac{1}{2}$ millimetres wide. The side, with a smoothed and polished surface, shows numerous particularly narrow concentric rings, resembling the annual rings of our trees. It is of a clear-brown colour, and has taken a good polish. The boundary of the medulla lies excentrically, and outside of this the external layers of wood, measuring two centimetres in diameter, do not complete the circle, but in many places sharply interrupted, so that an inner kernel intrudes in a certain manner on an external ring, which apparently proceeds from some sickness of the tree at the time of this separation, which, however, was fortunately healed, as the sound external layers of wood show. The bark shows very beautifully developed, long, warty cork-elevations, such as occur on the first two numbers, although less well developed, but on the other hand longer and wider. The colouring of the bark is very unequal; cross-cracks and adherent lichens are wanting. The fracture of the inner bark is finely splintery.

Anatomical Structure.—The cork is arranged in layers, and quite like that of the preceding numbers. The primary bark is the same as in Nos. 1 and 3, but its cells are less tangentially arranged. Resin-cells and lactiferous vessels are wanting. In the secondary bark the woody fibres are arranged in radial rows; they are present in great number, and beside them appear only seldom Schleiden's *Faserzellen* incompletely developed. Crystal cells, on the other hand, are present in both parts of the bark. *The tree appears to have been cut at a time in which no formation of wood and bark was going on*, since the layer of cambium consists only of a few rows of cells, and fully formed woody fibres border on these. [This seems very probable, as the tree was cut in September, after the

perfection of the flowering season, which, according to Pavon, is in July and August.] The very solid wood, which possesses no perceptible limitation of the apparently present annual ring, has numerous, short, many-celled medullary rays, which end above and below as simple particularly long rows of cells, so that the crosscut shows between every two medullary rays of many rows many medullary rays in single rows. The cells, which form the continuation of these medullary rays, much resemble the cells of the parenchyma of the wood, and are porous like these, whilst the long and strongly thickened woody cells are sparingly spotted in a radial direction. The arrangement of the medullary rays is unique (*eigenthümlich*), such as I have not noticed in any other wood, and one must perhaps think that at least it is peculiar to the *Cinchonæ*. The wood-cells and the wood-parenchyma are scarcely to be distinguished in a cross section; the latter, on the other hand, ever show in the lengthwise cut horizontal crosswalls. The vessels (which normally appear in pairs, even in four and more, and then as radial rows) show a round hole in the obliquely placed cross partition. Their lengthwise partition is thick beset with particularly fine dots.

No. V.—TWIG OF THE *C. SUCCIRUBRA*, Pavon.

If we examine a twig of *C. succirubra*, provided with leaves and flowers, we find that even at the lowest part of the twig, which is $5\frac{1}{2}$ millimetres in thickness, no cork is yet formed. The examination shows an epidermis formed of small cells without any coloured contents, which gives rise to hairs consisting of two or three cells. Beneath these appears the commencement of a young cork-formation, in which each cell contains a red ball of colouring matter; then follows the primary bark, in which some crystal cells are scattered. The cells of this are smaller and more regular, and the cell-walls are more swollen by alkali. The colour is also brighter than in No. 4. The limit between the primary and secondary bark is still more definitely brought out than in the older bark of the same sort. On the other hand, both the cork and the primary bark in their arrangement show great similarity with the older barks of the same tree. The still very young secondary bark is without colour, and of soft consistency; the parenchyma of the liber forms, as in the older barks, narrow, many-celled, radially-directed rows, which are parted by one-celled rows of somewhat radially-stretched cells, the single-celled continuations of the many-celled medullary rays of the middle portion. The cortical fibres are not yet developed; the wood is quite as in No. 4, only that the lacunæ, with round holes in their obliquely-placed cross-wall, are narrower and more numerous. The continuations of the medullary rays form also here radial one-celled rows, whose prolongations, as we just now saw, run into the bark. The woody cells are long and much thickened, and the lengthwise partitions of the lacunæ are furnished with the same numerous small dots as in the older wood (No. 4). The medullary rays finally are as there also, in many rows, still somewhat narrower, so that altogether the collective cells are more narrow than in the older wood, which finally affords a tolerably universal peculiarity for the wood of the first year.

After describing the bark of *C. lucumæfolia* and that of *C. micrantha* and *rotundifolia*, Wedd., Dr. Schacht adds in conclusion:—

“If we now compare together the preceding investigations, we find as characteristic of the true Red Bark of the *C. succirubra*, Pavon,—

"1st. The entire absence of resin-cells and lactiferous vessels in the primary bark.

"2nd. The appearance of numerous, polygonal, rounded, woody fibres, in single radial rows, in the secondary bark.

"These two characters are characteristic alike of the youngest as of the oldest bark, and distinguish these at first sight from the two other barks not produced by the *Cinchona succirubra*.

"The Nos. 1-4 barks, examined by me, were sent by John Eliot Howard to Dr. Klotzsch: they are collectively from the same trees (*Cascarilla roja*).

"My comparative microscopical investigation confirms and explains in part Howard's statements. The tree appears indeed to undergo only a gradual increase in thickness, like all hard kinds of wood more or less; the formation of bark, however, appears to take place still slower, since in a stem-diameter of 17 centimetres, the bark is not above $1\frac{1}{2}$ millimetres thick, but the same has lost nothing through the formation of cork (No. 4)."*

"The formation of the woody fibres follows later, as the flowering twig shows us, certainly not before the second year of its growth; thus far the epiderm is covered with hair composed of many cells, under which the first cork-formation finds place. The cells of the primary bark are here smaller, and in all directions of nearly equal diameter. The middling strong quills (No. 3) are then still provided with particularly smooth bark without cork-warts, and here and there covered with a light white coating, which appears to consist of a very tender lichen. Until then, no formation of outer bark has taken place. The cells of the primary bark have, on the other hand, increased, and become arranged in a somewhat tangential manner; also the limits of the primary and the secondary bark are in the thinnest pieces still unequally sharper than in the thicker examples. The medullary rays until these limits, where they end in a keel-form, are still plainly to be traced, which later is not the case. The formation of the cork-warts takes place particularly beautifully on the section of the stem No. 4; these are well preserved, but much smaller than on the thick bark pieces (Nos. 1 and 2). The white lichen covering is wanting. There has not yet taken place even here any formation of periderm; still the limit between primary and secondary bark is still particularly sharp, and the cells of the first less tangentially arranged than in the former number. Now since the specimens arranged under No. 3 are, in part, almost twice as thick as those of the No. 4, but still collectively appear without cork-warts, the appearance of these must, as I think, not be ascribed to any definite age. But still with age begins the formation of periderm, through which not unfrequently almost the whole primary bark disappears, as has taken place in No. 2, from the eldest stem, whilst No. 1, belonging to stout branches, has only thrown off a part of the outer bark. Now whether in quite old trees the formation of periderm extends itself even over the secondary bark I cannot decide. In all the examples examined by me, I have seen the periderm only press upon the limits of the secondary bark. Through the extension of the bark, which must follow the thickening of the stem, the earlier regular arrangements in the outer part become with age more or less troubled, but the younger parts of the secondary bark always keep their characteristic arrangement.

* Unfortunately we cannot estimate the age of the stem No. 4, since annual rings are wanting, which apparently here and there are much obliterated.

The anatomical contents of the younger part of the secondary bark remain accordingly the same, so long especially as woody fibres become formed; these are in the Red Bark always arranged in single radial rows. On the other hand, Schleiden's *Faserzellen*, which in this sort of bark especially occur only seldom, appear in unequal proportions in the same crosscut.

"The cells become more or less changed at the limits of the primary and secondary bark with increasing age, through the thickening of the regular disposition of the cells; so likewise in the primary bark, when such does not disappear through formation of periderm, the cells assume with age a tangential lengthening. Resin-cells and lactiferous vessels are wanting in Red Bark of every age. The number of crystal cells varies. The formation of the periderm begins first with age, also the formation of cork-warts, the presence of which is characteristic of old barks."

Dr. Karsten found in Delondre's "rouge pâle" variety of Red Bark, broad lacunæ (*Softfasern*), whilst in the "rouge vive" variety of the same author he could find no trace of these elementary organs.* Does this indicate a specific difference, or is it dependent on the place of growth, or on the degree of maturity of the branches. I confess that my own opinion inclines to the latter hypothesis, since careful investigation shows me these lacunæ as existing in the youngest bark of Pavon's collection; in those of more mature formation they begin to be obliterated, and in the oldest stem-bark (though from the same tree) they entirely disappear. These observations I have made on the bark of *C. succirubra*, Pavon's specimens (partly from Madrid, partly from Dr. Reichel's collection), and the presence of the same elementary organs is also very manifest in Dr. Radlkofer's sections of the bark of *C. succirubra* as found in the British Museum. Thus, whilst in the false Red Bark, from *C. magnifolia*, these lacunæ become by degrees developed into very large and conspicuous lactiferous vessels, in the true, on the contrary, they rather speedily become obliterated, and disappear entirely in the stem- or root-bark in which the colour is the brightest.

This is in many respects one of the most remarkable of the species of Cinchona. In richness of medicinal properties it much exceeds the common barks of Peru, and indeed rivals the best Bolivian bark in the quantity of alkaloids which it contains. The price at which it sells in the market is not only high in proportion, but beyond all proportion, exceeding that of all others: fair average samples being valued at more than twice the price of Calisaya bark. It is consequently used to but a small extent in the preparation of Sulphate of Quinine, the quantity which comes into the market being insufficient to meet the demand for other purposes. It is thus rich in alkaloids, although the unscrobiculate leaves, and the general analogy which prevails between the *C. succirubra* and the *C. cordifolia* should, according to Dr. Karsten's theory,† indicate an inferiority in alkaloidal contents.

* Die Medicinischen Chinarinden Neu-Granada's, p. 43.

† "It is certainly to be received as correct that the *Cinchonæ* which are furnished with capsules opening first from the base, and most crowned with the remaining calyx, and in addition have the corolla of tender structure and bearded border, and also for the most part have an unbroken border of the winged seed, give barks which serve, in a pharmaco-dynamic sense, as antiperiodics, whilst the species of the family *Ladenbergia* characterized by capsules beginning to open from the top, and mostly divested of the remains of the calyx, and characterized by a (for the most part) large, leathery corolla, furnished with felt-like, hairy border, possess only astringent or tonic virtues.

"But not only the presence or the absence of Quinine or Quinidine may be judged of by the differently formed external organs, but the ordinary medium yield of these organic bases in the barks of the different valued species of Cinchona may be approximated to from the form of the same. The short, oval or elliptical capsules, crowned with the calyx, the unbroken

Whilst these pages have been passing through the press, I have received from M. de Vrij specimens of the *Cinchonæ*, which, thanks to the exertions of the Government of Holland, are now flourishing in Java. Amongst these M. de Vrij has obligingly sent three leaves and stipulæ of "*Cinchona succirubra*, Klotzsch, from a small tree five feet high." These have entirely the aspect of the leaves which I received from Chimborazo,—one which is highly characteristic and distinct from all others. The shape however approximates more to the *No. 5 form*, and to those sent with my specimen-tree, than to the normal *C. succirubra* of Pavon's Collection, equivalent to the *No. 1 form* described above. This is valuable as confirmatory of the derivation of these varying forms from one species. The unequal development of the opposite sides of one of these leaves is very remarkable, although they bear the aspect of luxuriant growth. The largest leaf measures thirteen inches in length by seven in breadth.

On the 14th December, 1859, a paper was read before the Linnæan Society from R. Spruce, Esq., describing the results of an attempt recently made to visit the native locality of the Red Bark. After encountering great difficulties, he succeeded in penetrating the forests of Alausi to the point near the village of Chunchi, almost on the same spot as that from whence the specimen tree previously described was taken (Sibambe), and the specimen leaves (from Linchy), if I am right in identifying this place with the Linje of the map of Villavicencio, since all these three places appear to be within a few miles of each other.

Following the track opened out by his companions, Mr. Spruce plunged into the depth of the forest, meeting every few minutes with prostrate naked trunks of the *Cinchona*, but with none standing. His guide several times climbed trees on the hillsides whence he could look out over a large expanse of forest, but could nowhere get sight of the large red leaves of the *Cinchona*. This account confirms previous statements as to the havoc committed through the present mode of collecting the bark. At length, on their return by a different route, along a declivity not previously explored, they came on a prostrate tree, from the root of which a slender shoot, twenty feet in height, was growing. Mr. Spruce's first care was to verify a report that had been made to him by the collectors, to the effect that the tree had milky juice. This appeared strange and incredible in the Natural Order *Rubiaceæ*. When a slit was made in the bark by a cutlass, it soon appeared that the juice is actually colourless, but the instant it is exposed to the air it turns white, and in a few minutes afterwards red. The more rapidly this change is effected, and the deeper the ultimate tinge assumed, the more precious is the bark presumed to be. It is understood to be rare to find shoots springing from an old root, because the roots themselves are generally stripped of their bark, which together with that from the lower part of the trunk, is called, from its scabrous aspect, *Cascarilla costrona*, and is more valued than that from any other part of the tree.

winged border of the seed, as also the little pits (*scrobiculæ*) which occur in the axils of the veins near to the midrib in the relatively small leathery leaves, are signs of a normally greater product of alkaloids in this species; whilst the larger-leaved sorts without scrobicules, as well as those with long, lanceolate or oblong capsules, or with porous and broken borders of the wing of the seed, as we find in the *C. purpurea*, R. and Pav., the *C. Tucujensis*, Karst., and the *C. cordifolia*, Mutis, enable us to decide upon either an entire failure in the production of Quinine and Cinchonine, or on a very small proportion of these alkaloids. These morphological relations to the contents in organic bases, correspond in like manner with the climatic conditions which limit the unfolding of the different sorts, and the area of dispersion dependent upon these."—Karsten's 'Medicinische Chinarinden Neu-Granada's.'

The *Cascarilla roja*, according to Mr. Spruce, seems to grow best on stony declivities where nevertheless there is a depth of humus, and at an altitude of from 3000 to 5000 feet above the sea. The temperature is very much that of a summer's day in London, though each day towards evening cold mists blow down the valley from the ridges of Assuay, and for five months in the year, from January to May, there is almost unceasing rain.

In reference to the "*Guaco*" mentioned above, I owe to the kindness of D. Hanbury, Esq., the following extract from a letter from Richard Spruce, Esq., dated Ambato, Republic of Ecuador, 24th October, 1859.

"Remedies for snake-bites are perhaps more interesting than any others in hot countries. If the methods of cure prescribed in many medical books published in Europe were practised here, the patient would be dead long before the remedies could take effect. In most cases, all external applications are futile for arresting the progress of the poison after the first few minutes. There has been much dispute as to what is the true '*Guaco*.' Any one who has lived much among the Indians knows that their names for natural objects are *generic*, and that their genera do not always coincide with those of naturalists. Thus any twining plant with a heart-shaped leaf, white and green above, and purple beneath, is called '*Guaco*.' The *Guaco* most esteemed on the Orinoco is an *Aristolochia*, often called *Guaco del monte*, to distinguish it from the *Guaco del rastrojo*, as the *Mikania* are called, because they trail about stubble-fields or deserted 'chacras.'

"A similar *Aristolochia*, with a very aromatic stem and root, is frequent in the Maynensian Andes, where it is known as Machácin-huásca, or Snake-vine."

The substance above described as Cinchotannic acid has been analyzed for me by Mr. John Morland.

"The following are the results obtained in three combustions:—

	(1.)	(2.)	(3.)	(Mean.)
Carbon	69.28	68.94	68.92	69.05
Hydrogen	9.03	8.90	8.85	8.93
Oxygen	21.69	22.16	22.23	22.02
	<u>100.</u>	<u>100.</u>	<u>100.</u>	<u>100.</u>

"The formula (empirical) $C_{46} H_{36} O_{11}$ would have the following percentage composition:—Carbon, 69.00; Hydrogen, 9.00; Oxygen, 22.00. The substance was carefully dried, at 115° Centigrade, in an oil-bath, and was an almost inodorous orange-yellow powder."

Schwartz found the following as the composition of what he calls Kinovic Acid:—

Carbon	68.90	68.80
Hydrogen	8.85	8.87
Oxygen	22.25	22.33
	<u>100.</u>	<u>100.</u>

This is probably identical with the substance above described, consequently not exactly Kinovic Acid, but rather the mother-substance from which the Cinchona-red and various other products of the *Cinchonæ* are derived.

* Centralblatt, 1852, No. 13.

The Chinovine of MM. Hlasiwetz and De Gilm,* derived from the *Quina nova*, is evidently an analogous body, a Glucoside, which divides into a particular sugar and the *pure* Kinovic Acid, which latter has the composition $C_{48} H_{38} O_8$.

The Cinchona-red obtained by Schwartz from Calisaya bark was found by him to possess the following composition :—

Carbon	. . .	53.63
Hydrogen	. . .	5.36
Oxygen	. . .	41.01
		100.

This last is evidently an oxidized product. The purple vapour arising from the dry distillation of Cinchona barks cannot be relied upon as a distinct evidence of their value. The same, or a very similar effect is produced by heating Cinchona-red alone, and by heating the alkaloids with cellulose and other hydrocarbons, as shown by Batka, in a paper on this subject in Centralblatt, 1859, No. 55.

* Annal. der Chemie und Pharm. t. cxi. p. 182.



CHINCHONA OVATA.

CHINCHONA OVATA, foliis oppositis, petiolatis, ovatis, subtus tomentosis; pedunculis paniculatis; floribus subcorymbosis.

Cascarillo palido, Ruiz, *Quinologia*, Artic. 7, p. 74.

Arbor sexorgyalis, comâ frondosâ, patente. *Truncus* erectus, simplex, teres, ramosus. *Cortex* extus cinereo-lutescens, parum compactus, lævis, rarius variegatus, intus obscure fulvus, amarissimus, acidulus, levis: virtute febrifugâ pollet. *Rami* seniores erecto-patentes, teretes; *juniores* obtuse quadrangulares, pubescentes, fusci, superne foliosi. *Folia* approximata, opposita, petiolata, ovata, ampla, integerrima, patentia, plana, supra nitidissima, subtus tomentosa, venosa, venis purpurascensibus; *tenerima* utrinque tomentosa; nonnulla ovato-ovalia. *Petioles* purpurei, sesquipollicares. *Stipulae* interfoliaceae, oppositae, supra-axillares, magnae, basi connatae, adpressae, ovatae, obtusae, integerrimae, avenaceae, virescentes, deciduae. *Panicula* terminalis, magna, foliosa, subracemosa, composita. *Pedunculi* brachiati, longi, tetragoni, sulcati, multiflori, pubescentes. *Flores* subcorymbosi, breviter pedicellati. *Pedicelli* pubescentes, bracteolis suppositis, alternisque concavis, subulatis, deciduis, ad basim petiolorum insertis. *Calyx* purpureus, glaber. *Corolla* extus purpurea, pubescens. *Limbus* patens, intus hirsutus, albus. *Antherae* basi bifidae. *Capsula* oblonga, angusta, glabra, leviter striata, a basi ad apicem dehiscens, bivalvis, valvulis cymbæformibus apice coalitis. *Semina* fulva, alâ oblongâ leviter lacerâ helvolâ cinctâ.—*Habitat* in Andium montibus, imis, nemorosis, calidis, versus Pozuzo et Panao. *Floret* a Junio ad Octobrem. *Vernacule*, *Cascarillo de pata de Gallereta*.—*Observ.* Hanc speciem in Pozuzo et Panao, anno 1784, offendimus.

This species appears to me to be distinct from all others. I have therefore omitted some remarks which were added by Pavon at a time subsequent to the original description, and designed to identify the *C. cordifolia* of Mutis with that here described. Ruiz says* that he and Pavon, judging “from the barks and incomplete specimens in a bad state, which they received from Mutis, of the *Cinchona cordifolia*, and comparing these with the barks and specimens of their *Cinchona ovata*, were inclined to think that the two species ought to be united, but could not arrive at any certainty without seeing complete and well preserved specimens.”

Since the time of these botanists, the species has been carefully defined, and separated by Weddell and others from the *C. cordifolia*, which itself (according to the description and specimens sent by Don J. M. Restrepo†) shows well-marked varieties. Nevertheless it must be admitted that a very close analogy, though not (in my opinion) identity, exists between the two; as may be seen by comparing our drawing, made from specimens of Pavon’s in Madrid and London (agreeing very closely with Plate 195 in the ‘*Flora Peruviana*’), with Karsten’s beautifully executed plate of *C. cordifolia*, Mutis.‡ On the other hand, there is some want of correspondence in the form and texture of the leaf, between

* Suplemento, p. 56.

† The following remarks on the *C. cordifolia* of New Granada were sent (together with specimens now in Sir W. J. Hooker’s herbarium, at Kew) by Don J. M. Restrepo, under date “Bogotá, 13th December, 1850.”

“*C. cordifolia*, No. 1.—The fruit of this species is long, yellow, and abundant; it is found in the forests, under a higher temperature than the *lancifolia*.

“*C. cordifolia*, No. 2.—There appears to be some difference between this species and the former. The fruit is smaller and of a black colour. The fibres of the leaves have but little red, rather inclining to green.”

‡ Karsten’s ‘*Floræ Columbæ Specimina Selecta*,’ pl. 8.

the *C. ovata* as figured in the 'Flora Peruviana' and by us, and the *C. ovata, a vulgaris*, of Weddell, as delineated by him and as existing in a specimen given by that gentleman to me and marked by his hand, "*Cinchona ovata*, Ruiz et Pavon, *a vulgaris*, Weddell, *Monogr.*: Ravin de Pelecucho, Prov. de Caupolican, Bolivia." The same observation will apply to another specimen from the same quarter, marked "*Cinchona ovata*, Ruiz et Pavon: Montagnes de San Juan del Oro, Prov. de Carabaya, Pérou." Further there appears a considerable resemblance between our drawing and a specimen from Dr. Weddell, marked, "*Cinchona cordifolia*, Mutis: Vallée de Tambopata, Prov. de Carabaya, Pérou;" so that on the whole I am inclined to believe that our *C. ovata*, the source of the bark called by Pavon *Pata de Gallereta*, is a distinct species, assimilating more nearly to the *C. cordifolia* of Weddell than to his *C. ovata*, and moreover that both are distinct from the *C. cordifolia* of Mutis. Not having had the opportunity of observing the trees in their native localities, I give these observations with considerable hesitation; they are however necessary to introduce my remarks on the barks themselves.

In the first place it is evident that the *Pata de Gallereta* bark, as it exists in Pavon's collection, is not the same with the *Ash Bark* of Pereira, with which it has been identified. Neither does it coincide with the bark of *Cinchona ovata*, the *Pata de Gallinazo*, as given me by Dr. Weddell, nor with other specimens sent to Dr. Lindley, but stands, so far as I can see, very much isolated. It does not agree with the *C. cordifolia* of Mutis, although it has some features in common. The nearest affinity which it possesses appears to me to be with the bark of the *Cinchona ovata*, var. ined. *macrocarpa*, Weddell, given me by this celebrated botanist, a sort which is not unfrequently met with in commerce, but is of inferior quality. I do not think the *Cascarilla de Pata de Gallareta* is ever found in commerce, unless by accident, or perhaps as a fraudulent admixture. It has the characteristics of a bark of very little value, such as is described by Ruiz and Pavon; and the specimen of Pavon gives no purple sublimate when heated, so that it probably contains little, if any, Cinchotannic Acid. I am unable to give any definite information as to the contents in alkaloids.

The microscopical examination presents much analogy with the *C. ovata* of Weddell, but the ligneous fibres appear much more in radial rows in the specimen of Pavon than as represented in the 'Histoire du Quinquina,' pl. ii. fig. 40.

It appears that M. Hasskarl sent to Java the seeds of a species of *Cinchona* which he believed to be the *C. ovata*. These have vegetated and produced flourishing plants in their new place of growth, but M. Junghuhn is more inclined to consider them the *C. lucumæfolia*. M. De Vrij has kindly sent me beautiful and well-preserved specimens, both in flower and fruit, and they appear to me to be quite distinct from both the species named, and to have more in common with the *C. Carabayensis*, Weddell, although the somewhat imperfect specimen in my possession of this last does not enable me fully to decide the question. The blood-red colour of the capsules when fresh is very remarkable, according to Weddell, in the species which he has so named. I have not heard whether this is the case in Java, in the variety sent from thence, the general colouring of which appears to have been different from Dr. Weddell's specimen.



W. Fitch del. et lith.

CINCHONA MAGNIFOLIA. Pavon.

Cascarilla Flor de Azahar.

Spurious Red Bark.

W. West imp.

CHINCHONA MAGNIFOLIA.

CHINCHONA MAGNIFOLIA, foliis oppositis, petiolatis, oblongis ovalibusque, pedunculis paniculato-corymbosis, corollis albis. *Sp. Pl. Fl. Per. et Chil. vol. ii. p. 53. ic. 196. Cascarillo amarillo*, Ruiz, *Quinologia*, Artic. 6, p. 71.

Arbor 40-ularis, comâ frondosissimâ, erecto-patente. *Truncus* solitarius, erectus, teres. *Cortex* læviusculus, fusco-cinereus, intus fulvus, amarus, acidulus, non ingratus, in febribus propinari potest. *Rami* seniores teretes, læves, fusi coloris; *juniores* obtuse tetragoni, foliosi, dilute rubescentes. *Folia* opposita, petiolata, ampla, oblonga ovaliaque, nonnulla obovata, integerrima, pallescentia, supra nitida, subtus venosa, per nervos et ad basim venarum setis mollibus numerosis fasciculatis albidis. *Majora* 1-2-pedalia, per nervos purpurascentia, marginibus revolutis. *Petioles* semiteretes, purpurei. *Stipulae* supra-axillares, interfoliaceæ duæ, oppositæ, appressæ, basi coadunatæ, ovatæ, integerrimæ, acuminatæ, aveniæ, deciduæ. *Pedunculi* communes axillares terminalesque, paniculato-corymbosi, subteretes: *partiales* bracteolis parvis, oppositis, sessilibus, ovatis, concavis, acutis, persistentibus, ad basim et in medio unita bracteola stipati. *Calyx* purpureus, parvus. *Corolla* alba, extus pubescens, Citri Aurantii odore, laciniis intus pubescentibus. *Capsula* oblonga, fere sesquipollicaris, obsolete striata, leviter curvata, apice hians, bilocularis, bivalvis. *Semina* ovalia, fulva, alis scariosis inæqualiter laceratis cincta.—*Habitat* in Andium nemoribus calidissimis prope torrentes copiose ad Chinchao, Cuchero et Chacahuassi. *Floret* Maio, Junio, et Julio. *Vernacule*, *Flor de Azahar* aut *Cascarilla flor de Azahar*, propter corollæ odorem, Citri Aurantii florum odori simillimum. Hujus corticem D. Sebastianus Josephus Lopez Ruiz primus è Regno Novo-Granatensi in Hispaniam attulit, unde cum Galliæ, Italiæ, et Angliæ Academiis per clar. Casimirum Ortega communicatus est, ejusque usus variis experimentis institutis propagatus.

Quina Roja, o *Azahar* del Doctor Mutis.—*Observ.* Anno 1780 hanc speciem in Cuchero descripsimus.

The *Cinchona magnifolia* of Pavon furnishes a good illustration of a family nearly allied to the *Cinchonæ* in some characteristics, but in others markedly distinct from this latter genus, as it is at present restricted. These inhabit a warmer zone than the *Cinchonæ*; and whilst rich in colours and forms that delight the eye, and also in fragrant essential oils that fill the air with sweetness, they are useless in a medicinal point of view, and are therefore often classed together in commerce, with others equally worthless, under the general appellation of *false barks*.

It appears that Linnæus, in the tenth edition of his works, published at Stockholm in the year 1759, first gave the true character of the genus *Cinchona* in the following words: "Capsulis a basi ad apicem dehiscentibus!" but in the twelfth edition, published at the same place in 1767, this correct terminology is abandoned; and it is tolerably evident that this was owing to information given by Don J. C. Mutis, of Santa Fé, since in the interim Linnæus had received letters from this botanist containing leaves and fruit of some plant with capsules dehiscent from the apex, and sent as "*Cinchona Peruviana*."* These specimens, together with a rough sketch, by the last-mentioned hand, apparently of the *C. oblongifolia*, are preserved in the collection of the works and specimens of Linnæus in the Linnæan Society's rooms in London; and it was in looking over these with Dr. Reichel that we ascertained the facts I have stated. The credence given by the great Linnæus to Mutis was thus the

* Mutis in literis, Sept. 22, 1764, datis. According to Humboldt, Mutis discovered *Cinchona*-trees in 1772. See Lambert's 'Illustration,' etc., page 26.

occasion of confusion, which Endlicher* was the first to clear up again, and to establish with precision the genus in the form which is now generally admitted. Endlicher gave the name "Cascarilla" to the rejected species, forming them into a genus under this name, to which Klotzsch has objected,† considering the definition not to be sufficiently accurate, and has chosen another name, that of "Ladenbergia," for the tribe, attaching the designation Buena and Cascarilla to the subdivisions of the same. Dr. Klotzsch complains that Dr. Weddell misunderstood his definitions, and re-arranged his designations. Without giving any opinion on the merits of this question, I give the preference to the use of Dr. Klotzsch's word, "Ladenbergia," as it avoids the extreme inconvenience caused by the retention of the very misleading term "Cascarilla," as applied to the false barks.

The present species, since it is furnished with capsules dehiscent from the apex towards the base, may stand as a very good representative of the *Ladenbergia* of Klotzsch. According to Karsten these are characterized by large leathery corollas, furnished with felt-like hairy borders,‡ and by capsules beginning to open from the top, and mostly divested of the remains of the calyx. They occupy, according to this author, a zone of vegetation much beneath that of the true *Cinchona*, less frequently refreshed during the dry portion of the year by the ascending clouds and the descending rain-showers, and in this season they have to support a temperature ranging as high as 36° Centigrade (96·8 Fahr.), whilst in the winter the thermometer descends as low as 4° to 5° of warmth (39° to 41° Fahr.), and sunny morning hours are succeeded by rain from midday till towards midnight. This is consequently a region of intermittent vegetation, strikingly contrasted with that which appears to be the most favourable to the true *Cinchona*, and to the production especially of Quinine.

The classification of these plants has been treated differently by each one who has undertaken the task. Pavon appears to have intended that the present species should be widely inclusive, and apparently ranges under it those different forms of the *Corteza Azahar*, the *Azahar macho* and the *Azahar hembra*, of which Weddell constitutes another species, the *Cascarilla Riveroana*. This perhaps gives the explanation of the form represented in Plate cxcvi. of vol. 2 of the 'Flora Peruviana,' which is nearer to the *C. Riveroana*, Weddell, or the *Azahar macho*, than to the normal *Azahar*, as represented both in Pavon's collection and also in the herbarium of Sir William J. Hooker. This may also be assigned as a reason for the confident assertion§ of Ruiz and Pavon, that their plant was the same with the *C. oblongifolia* of Mutis, to which, as will be seen in the sequel, I can give only a modified assent.

Lambert, in his 'Illustration,'|| calls this assertion in question, and refers, amongst other points which he regards as distinctive, to the cordate form of the leaf of the plant of Mutis. In the present Plate, which was drawn by Mr. Fitch from specimens at Madrid, it will be observed that

* In his 'Genera Plantarum,' p. 556.

† Klotzsch, 'Ueber die Abstammung der Rothen Chinarinde,' pp. 56, 57.

‡ If the reader will place together our Plate of this species, which is equivalent to the *Cinchona (Ladenbergia) caduciflora* of Humboldt, with our Plate of *C. micrantha*, containing the *Cinchona Reicheliana* (which had been erroneously identified with the *C. caduciflora*) he will see very clearly brought out the contrast between the flowers in the two genera.

§ "It is beyond contradiction that the *Cinchona oblongifolia* of Dr. Mutis constitutes one and the same species with our *Cinchona magnifolia*, or *lutescens* of Ruiz."—Suplemento, p. 53. Compare also Pavon's definitions above.

|| 'Illustration of the Genus Cinchona,' p. 12.

the larger leaf is cordate, so that this form cannot be regarded as distinctive, unless it be from the *C. Riveroana*, Weddell.*

Poeppig likewise describes the *C. magnifolia* or *Corteza de Azahar* as "a stately tree, with unusually large white flowers," which could scarcely be said either of the *C. magnifolia* (*caduciflora*), Humboldt, or of the kind carefully drawn by Mr. Fitch from fruit-bearing branches in Pavon's collection at Madrid, the flowers being added from a specimen of Pavon now in my collection, which coincide with Humboldt's *caduciflora*, except in the *macho* rather than the *hembra* development of the flower, and in the shape of the capsules, which latter agree best with those of the Plate excvi. of vol. 2 of the 'Flora Peruviana.'

I have received, through the kindness of Dr. Karsten, a specimen of his *Cinchona Bogotensis*, a plant which approaches to the present form, and to the bark of which is attached also the name *Quina roja*, *Cascarilla roja*, *flor de Azahar*. The leaves differ somewhat in type of the nervation, and in a more oblong outline, but the flowers are much more remarkably dissimilar, being unusually large and fine, and about twice the length of the very large ones represented in the 'Flora Peruviana.' The capsules are about five inches in length, instead of one and a half, as in our species. These particulars coincide with the description of the *C. oblongifolia* given by Humboldt,† in which he says that the leaves of this plant are oblong, smooth, and the capsules of larger size than those of the *C. ovalifolia*. The plant is ticketed as having been gathered at Servitá and Susumúco, near Bogotá. Dr. Karsten has been good enough also to send me a copy of a plate of this species, prepared for a future number of his very interesting work.‡ The large leaves, twelve inches in length by seven and a half in width, which form part of the specimen sent me, are rather more oblong than those represented in the above plate. Probably either this or the next species is the true *Cinchona oblongifolia*, Mutis, for it is scarcely to be credited that so able and zealous a botanist as Dr. Karsten should have explored the particular district where this species should be met with without being able to find it. Especially unlikely does this seem when we take into account the statement of Mutis, that the tree furnishing his *Quina roja* is exceedingly common in the country.§

Again, if the reader will compare our figure of *C. magnifolia* with that of the nearly allied *Cinchona heterocarpa* in Tab. vi. Fasc. 1 of Karsten's work, he will be struck with a very close resemblance to our plant, which has not been unnoticed by the author himself, as he says, "The *C. heterocarpa* is very similar to the *C. magnifolia*, Flor. Per., the capsules of which nevertheless open perhaps exclusively from the summit, and the hard, almost woody carpels do not separate themselves from the adherent calyx after the opening of the capsule." The differences, then, are scarcely so great between these two species as between some of the varieties soon to be mentioned of the *C. magnifolia*. More-

* A specimen exists in the British Museum marked *C. vulgo Azahar*, ex Jaen de Loja, inedita, which appears to be nearly identical with the *Cascarilla Riveroana*, Wedd., and on this is marked in pencil, "*Cinchona oblongifolia*, Mutis." The base of the leaves is, however, much more obtuse than in the *C. Riveroana*, as figured by Weddell, and this tendency verges (according to Karsten) into a heart-shaped form in specimens of *C. oblongifolia* brought by Humboldt, and now in the Berlin Museum.

† 'Mag. der Gesellschaft der Naturforschenden Freunde,' Berlin, 1807, p. 116.

‡ 'Floræ Columbiae Specimina selecta.'

§ *Quina roja*. "El árbol que la produce es abundantísimo, y correspondiente á igual número á las dos restantes especies juntas, amarilla y blanca."—Instrucción sobre las Quinas, MS. Brit. Mus. Mutis.

over this species is given as equivalent to the *C. nitida* of Benthams, the *Cascarilla nitida* of Weddell, of the bark of which species I possess a specimen, gathered near Fusaguasagua, and therefore in the particular district of New Granada, from which the *Quina nova* has, not only in the times of Mutis, but also of late, been imported, and this specimen agrees much more closely in external appearance with the aspect of *Quina nova* than does the *C. magnifolia* of Pavon.

The particular species we have under notice is considered by Dr. Weddell to present several distinct varieties, which he classes together as α *vulgaris*, β *caduciflora*, and γ *rostrata*. To this list should be added at least one other form, that of the *Cascarilla margarita* of Pavon, which perhaps does not present any very salient points of divergence, according to a specimen in my possession given by the authorities of the Museum of the Jardin des Plantes, and marked by Dr. Weddell himself as *C. magnifolia*. The bark, however, according to Pavon's specimens, is a peculiar sort of spurious red, differing from that of the *C. magnifolia*.

On the whole it is scarcely possible to avoid the conviction that we have several permanently distinct forms comprehended under the general name of *Azahar*. The same conclusion appears to be arrived at by Dr. Lindley, in his 'Flora Medica,'* and also by Dr. Weddell, in his 'Histoire Naturelle des Quinquinas,'† who remarks that "the varied forms which we observe in this species proceed especially from the development of the sexual organs, of which mention has been several times made in this work, and which, when it becomes marked, constantly brings with it greater or less modifications in the other parts of the plant. The corolla is above all invariably affected by the changes which take place in the relative length of the stamens and pistil. It is upon a lengthening of the tube, concomitant with the elongation of the style and the shortening of the stamens, that Bonpland founded his *C. caduciflora*. Varieties of a similar nature are found in many of the species of *Cascarilla*."

It is perhaps to be regretted that (on account of variation in the opening of the capsules) Karsten should have placed back some of these plants amongst the *Cinchonæ*; whilst, on the other hand, the very valuable information he gives us tends to remove the erroneous impression that the transition is so immediately absolute from the one to the other family as might otherwise have been supposed. In this case also we find the truth of the adage, "*Natura nil facit per saltum*." The true *Cinchonæ*, according to Pavon, vary much in the above respect. The *C. ovata*, Pavon, in its large hairy unscrobiculate leaves, approaches the *Ladenbergiæ*. In microscopical constitution it assimilates yet more evidently to the allied family; and in the very appearance of the bark and the absence of the purple sublimate by heat, as well as in its small proportion of alkaloid, it approaches the *C. magnifolia*. On the other hand, our *C. magnifolia* stands nearer than the *C. Bogotensis* to the true *Cinchonæ*, both in the persistent character of the calyx and in the form and size of the flower. Other similar observations will occur in the course of this work in reference to species of *Cinchonæ* which, in their climatic tendencies and consequent region of growth, as well as in their properties, fraternize with the *Ladenbergiæ*. These (classed together) are the *Cascarillos bobos* of the Spanish population.

Dr. Weddell remarks in reference to his genus *Cascarilla*, that "although there is much general affinity between these plants and those which compose the genus *Cinchona*, there are nevertheless

* Page 424.

† Pages 79, 80.

scarcely any of their essential organs which do not on examination furnish occasion for separating them." In confirmation of this view I may mention the great difference which exists in almost all their chemical constituents. They may in a practical point of view be considered as not producing alkaloids. Such is the opinion of Karsten, who has examined many of them on the spot. My own observations, made on the *Quina nova* and on the bark found in commerce, which I believe to be derived from the *C. magnifolia*, do not tend exactly to the same point. I have several times found present a minute proportion of some substance which behaves like an alkaloid. Its taste is more hot than bitter; it is soluble in ether, and gives a slight green colour with chlorine and ammonia. Messrs. Pelletier and Caventon obtained a similar proportion, or, as they say, "an infinitely small quantity." It is on this account that I have not carried out the research, which would probably show greater accordance even in this respect with some other families than with the *Cinchonæ*.

A similar conclusion strikes me in reference to the red colouring matter of these false barks. I am unable to trace in it the characteristics of the products of the cinchotannic acid of the *Cinchonæ*. It rather appears to me a substance *sui generis*; and I am confirmed in this view by comparing the accurate analysis of Hlasiwetz, who gives as the result the formula $C_{28}H_9O_{17}$ for the substance derived from the *Quina nova*, whilst Schwartz represents the cinchotannic acid derived from Calisaya bark as having the formula $C_{14}H_8O_9$.*

The general appearance of this "*Quina nova*," or bark of *C. oblongifolia*, Mutis, as brought to this country from New Granada, is that of large coarse pieces of bark, well called *cortezones* by the Spanish writers. They are frequently two feet long and from half an inch to several inches wide; some in my possession are more than one inch thick. The periderm has been removed, and the derm presents frequent cross-cracks occasioned by the process of desiccation. The surface is otherwise smooth, and of a purple-red. The substance of the bark is very heavy, and when cut across it presents a colour more of cinnamon than red. It is impossible to mistake the bark in this state for genuine red bark, but I have seen samples much more approaching in their appearance to the bark of *C. succirubra*, although the difference is still sufficiently apparent, and rendered more so by microscopical examination. I have in my possession a piece given me at Berlin as having been collected by Humboldt as "*China rubra de Santa Fé*," which is clearly *Quina nova*. The *China nova Xauxa* of Bergen's collection, according to a specimen now in my possession, is exactly the same, although grown in Peru.† The specimens of the *Cascarilla flor de Azahar*, Peru, *C. magnifolia*, R. and P., are of a much slighter character and lighter colour than the first-mentioned. Specimens given me by Dr. Weddell show that there is considerable variety in the bark, and lead to the thought that the different influences of the climate in the two countries might account for this discrepancy. I was myself accustomed to regard them as alike, but further microscopical examination disclosed so great a divergence that I was thrown back upon the examination of a piece of the bark of *Cascarilla carua*, Wedd., which agrees much more entirely with the aspect of the *Quina nova*, and tended greatly to convince me that the *C. oblongifolia*, as furnishing the *Quina nova*, must be regarded as differing from the *C. magnifolia*. Unfortunately Dr. Karsten did not succeed in preserving his specimens of the bark

* Gerhard's 'Chimie Organique,' tome iii. pp. 898-900.

† The Jauja is a tributary of the Marañon.

of *C. Bogotensis*, so that it is not possible to ascertain its identity with the *Quina nova*. No spurious bark that has fallen under my observation has been imported in such large quantities as this, and when reduced to powder its cinnamon-colour would cause it easily to be mistaken for a good bark. According to Ruiz,* it constituted the bulk of the early importations sent by Mutis from Santa Fé, and this fact is admitted by his disciple Zea.† It is therefore possible that the importation of so much worthless bark might cause the *Quina naranjada* to be also looked on with suspicion, and burnt, which seems to have been a practice followed with the inferior barks at Cadiz. The same fate befell a quantity of the *Quina nova* at Havre a few years since. Some small specimens came under my notice in September, 1849, amongst the first samples of bark sent in the renewed importations made from Santa Fé de Bogotá; and it has since been more largely imported from that quarter, and though sold at an extremely low price, has not ceased to come. Nor is it probable that the supply will fail so long as the welfare of the patient is neglected in favour of the pecuniary interest of the person who supplies him with cheap but inefficient remedies.

According to a MS. of Mutis now in the British Museum, the bark of his *C. oblongifolia* was used as a substitute for the original Red Bark, the supply of which had been exhausted;‡ and (to do him justice) he does not give a very favourable account of the therapeutic powers of this his *Quina roja*.§

Similar is the account of Ruiz, who says that it is a sort of small efficacy, and that it probably owed its reputation to having been confounded with the true Red Bark, since this latter came not unfrequently by way of Carthagena, and thus both sorts were sold as the *Quina roja of Santa Fé*. It was prescribed, not on account of its efficacy, but of the low price at which it could be obtained.

The statements of Zea are substantially to the same effect, and the practical results seem to have been very unhappily confirmatory of these testimonies.

In the Museum of Guy's Hospital, London, which I explored in hope of finding original specimens of the red bark used by Dr. Saunders (some time senior physician in that Institution), I succeeded only

* "*Azahar*.—Esta especie es de corta virtud, comparada con la de las superiores. Algunos han pretendido ensabrar mas de lo justo la corta eficacia de esta Quina. Este elogio puede haber provenido de haberla equivocado con la *Quina legítima colorada*, que tambien suelen llamarla *Roja*; pues vinienda muchas veces esta por la via de Cartagena de Indias, los comerciantes la han vendido por *Quina roja* de Santa Fe en las Potencias extranjeras, sin distinguir vendedores ni compradores la notable diferencia que hay en la actividad de la virtud de la una cotejada con la otra.

“De Santa Fe vienen muchas partidas de corachas de esta Quina y aunque ningun aprecio tiene en el comercio; se despacha y se da á los enfermos por el infimo precio á que suele comprarse.”—Ruiz, MS. B. M.

“To the great prejudice of the royal treasury, the thick bark (cortezones) of the *Roja* alone entered with absolute preference into his (Mutis's) immense cuttings; then the *amarilla* . . . and the *naranjada* or *tunita*, which he did not know till long afterwards, as it continued despised until he began to know the reprobation of his shipments of red barks (*cortezones rojos*).”—*Memoria de las virtudes y usos de la Raiz de la Planta llamada Yallhoy, etc. Por Don H. Ruiz. Madrid, 1805.*

† “The first species known, which obtained great estimation for its prodigious effects in intermittents, was the *naranjada*. This species being extremely rare, they substituted in its place the barks of the tree which appeared most to resemble it. This was, to the disgrace of those times of ignorance, the *Quina roja*, the properties of which being then unknown and much different from the *naranjada*, gave occasion to the havoc (*los estragos*) which history has transmitted to us.”—Zea, as quoted by Ruiz, *Suplemento*, p. 36.

‡ Instruccion sobre las Quinas, MS. B. M., signed by Mutis.—“*Quina roja*. Agotada la primitiva especie en sus antiques limites conocidos, le sustituiron . . . á cortar las accesiones, y sí lo hace algunas veces indirectamente y con malas resultas. Es un remedio abrasador, de donde dimana la opinion de llamar á toda Quina indistintamente *incendiaria*.”

§ I extract from the *Suplemento de la Quinologia*, p. 109, the following information from the pen of Dr. Mutis, which is stated to be the only botanical description of the barks of New Granada which he published. As the authority of Dr. Mutis

in meeting with one or two ordinary specimens of genuine Red Bark, but these first supplies appeared to have been supplemented by various purchases of *Quina Nova* marked as "*Red Bark*."

Dr. Fothergill, in 1782,* addressed to Dr. Saunders a letter from which I make the following extract.

"It has been remarked for many years past that the Peruvian Bark has often disappointed the expectation of the public, having fallen greatly short of that transcendent degree of efficacy for which writers of the last century have so highly extolled it. Few physicians of extensive practice but must sometimes have had the mortification *to observe their favourite specific entirely baffled by a regular intermittent*, without being able to assign any probable cause for the defeat except the unguineness of the medicine; whence it would seem to follow either that the intermittents of late years have been more *obstinate* in their nature, or that the bark has been of *inferior quality* to that which was used by Dr. Sydenham and many of his respectable contemporaries, of whose veracity we can entertain no reasonable doubt. The latter appears to me to be the more probable, when it is considered that of late years it has been customary (for what reason I cannot imagine) to select the bark of the small branches, under the denomination of *Quito Bark*, in preference to that of the trunk."

It follows that the substitution of the spurious *Quina Nova* for genuine Red Bark, must have given rise to great disappointment amongst Physicians, and equal disadvantage to their patients.

The characteristic product of the bark of the *Ladenbergia* is the substance discovered and named by Pelletier *Acide quinovique*, and which I have elsewhere mentioned as *Kinovic Acid*.† It is now proposed by Dr. De Vrij to recur to the term *Chinova-bitter*, applied by Winckler in his early researches to this complex glycoside. *Cinchona-bitter*, which De Vrij seems inclined even to prefer, is objectionable,

has been very prevalent, it is well to give the quotation in its original language and form, that it may lose nothing of its importance by translation:—"The following is the statement of the number and properties of the officinal barks inserted by Dr. Mutis in the periodicals of Santa Fé:—

EN LA BOTANICA— <i>Cinchona</i> .			
Lancifolia	Oblongifolia	Cordifolia	Ovalifolia
	<i>Quina</i> .		
Hoja de lanza	Hoja oblonga	Hoja de corazon	Hoja oval
EN EL COMERCIO.			
Naranjada primitiva	Roxa sucedanea	Amarilla substituida	Blanca forastera
EN LA MEDICINA: <i>Amargo</i> .			
aromatico	austero	puro	acerbo
balsamica	astringente	acibarada	xabonosa
antipyretica	antiseptica	cathartica	rhyptica
antidota	polycresta	ephRACTICA	prophylactica
nervina	muscular	humoral	visceral
<i>Febrifuga</i>	<i>Indirectamente febrifugas.</i> "		

This enumeration of qualities for the bark of the *oblongifolia* clearly points to the *Quina nova*, as his recognized *red bark*. It appears, however, that two sorts were brought by Dr. Lopez to Spain from New Granada, one of which may possibly have been the "*Quinquina rouge de Mutis*" of Messrs. Delondre and Bouchardat's '*Quinologie*,' pl. 18. Compare '*Suplemento á la Quinologia*,' p. 54.

* '*Saunders on Red Bark*,' p. 111.

† In recent letters from Dr. De Vrij, now in Java, he informs me that he has found the Kinovic Acid in *all* parts of the *Cinchona*-trees now growing in Java, viz. in the bark, wood, leaves, and roots. He says further, "My impression that this acid would prove a powerful medicine has been confirmed by some experiments made at Batavia. The chief of the medical service of the colony is so much satisfied with the result that he intends to order experiments on a large scale if only he can procure enough of the material." Referring afterwards to the discovery of Professor Hlasiwetz, that the so-called Kinovic Acid is a glycoside which may by the action of hydrochloric acid be separated into pure Kinovic Acid and a kind of sugar, De Vrij adds that the name of *Chinovin* would lead into error, and wishes that the term *Chinova-bitter* should be applied to the rough

as indicating too limited an origin for a widely-diffused product, which is not even characteristically that of the *Cinchonæ*.

This substance has not hitherto been supposed to possess any antiperiodic properties, and it could scarcely be used as a tonic, on account of its extremely nauseous taste. I have found it to possess (when first separated) a strong odour of capreolic acid. It pervades this class of plants (the *Ladenbergiæ*) in varying quantities, but on the whole bearing about the same proportion to the substance of the bark that the alkaloids do to the bark of the *Cinchonæ*. This seems to be in coincidence with the peculiarly large development of the lactiferous vessels, in reference to which Dr. Weddell observes, "The bark of all the trees of this genus which I had occasion to see living, presents, when deprived of its periderm, a more or less deep reddish colour, and speedily exudes from all its surface an opaque and very astringent gummy liquid, which assumes, in drying, a very characteristic blackish colour. The same liquid, which corresponds to the "milk" of the *Cinchonæ*, issues still more abundantly from the section of the bark, and above all from the layer which contains the lactiferous vessels (*lacunes*). This "milk" escapes "especially from the lactiferous vessels of the young branches"* of the Calisaya; and though the Cascarilleros ascribed peculiar bitterness to its taste, Dr. Weddell found it much less so than the interior portion of the bark. All these circumstances coincide very exactly with the peculiar qualities of the Kinova-bitter, or, as found in the Calisaya, the Kinovo-tannic Acid.

Dr. De Vrij has just published† the result of those observations which peculiarly favourable circumstances, conjoined with his great chemical skill, have enabled him to make amongst the plantations

product of the bark, especially since he finds "that the genus *Cinchona* produces a substance which is a mixture of two substances, viz. of the glycoside for which Hlasiwetz proposes the name of Chinovin, and of Kinovic acid. If therefore the bitter substance from the *Cinchonæ*, which is soluble in caustic alkalies and milk of lime, should be employed in medicine, it will be convenient to call it *Chinova-bitter*, or perhaps better, *Cinchona-bitter*, which name will then signify a mixture in varying quantities of two bitter substances totally soluble in lime-water and weak alkaline leys."

The word *Quinovine* has been applied to the peculiar alkaloids supposed to be present in *Quina Nova*.

* 'Histoire,' etc., p. 33.

† "Whilst occupying myself with the chemical examination of the Cinchona-trees now cultivated in the island of Java, which succeed there perfectly, I have carefully studied the Kinovic Acid which I have found in all the parts of the plant. The leaves, the wood, the bark, have all given notable quantities; but it is especially in the ligneous part of the roots that it is found in the greatest abundance. I present here the table of the proportionate quantities of Kinovic Acid found in the different organs of the *Cinchona Calisaya*, cultivated for five years past in the island of Java:—

100 parts of the wood of the roots	contain	2·57
100 parts of the bark of the roots	„	1·08
100 parts of the wood of the trunk	„	1·80
100 parts of the bark of the trunk	„	0·36
100 parts of the bark of the ligneous branches	„	0·68
100 parts of the herbaceous twigs	„	0·85
100 parts of the dried leaves	„	0·23

In comparing these quantities of Kinovic Acid with the quantities of alkaloids found in the same organs (with the exception of the leaves, which contain no trace of alkaloid), I have observed that they are found in an exactly inverse proportion, in such a manner that an organ,—as, for example, the bark of the trunk,—which contained a considerable quantity of alkaloids (about 4 per cent.), only contained a very small quantity of Kinovic Acid (0·36 per cent.); whilst the woody part of the roots, which contained only a very small portion of alkaloids (0·06 per cent.), contained, on the contrary, a considerable proportion of Kinovic Acid (2·57 per cent.). This particular relation, coinciding with the presence of ammonia, ascertained in all the organs, led me to suppose that the Kinovic Acid played an important part in the formation of the alkaloids of the genus *Cinchona*. Although the experiments which I have hitherto made to verify this supposition have failed, I nevertheless still present it as likely, and I hope to render my ulterior researches still more probable."—*Journal de Pharmacie et de Chimie*, April, 1860, p. 255.

M. De Vrij remarks that Kinovic Acid has, in common with all the active principles of the *Cinchonæ*, the power of deviating the plane of the polarization of light. I cannot find any polarizing power, on the other hand, in the alkaloids of the *Ladenbergiæ*.

of Cinchona-trees at Java: from these he deduces the very interesting fact, that even in the different parts of the Calisaya-tree the Kinovic Acid holds an inverse proportion to the Alkaloids, coinciding in this with the law which regulates the distribution between the two families we are contemplating. Dr. De Vrij is sanguine as to the good results likely to be obtained in medicine from the exhibition of this product.

According to Dr. Weil, on the other hand, Kinovic Acid possesses no antifebrile power. This was particularly striking in the case of a person affected with tertian ague. No change at all occurred in the symptoms through taking Kinovic Acid, but an ordinary dose of twenty-four grains of Sulphate of Quinine, in twelve doses, effected a permanent cure.*

For general anatomical observations on the *false barks* as compared with the true, I refer with pleasure to the elaborate and highly interesting microscopical observations of Dr. Schleiden,† and also to Dr. Karsten's investigations, which possess peculiar value, since this botanist has been able to carry out his researches in the native country of these plants; and has thus been enabled to give us clearer insight into the relations prevailing between climate and structure, and between these and the value of the barks, dependent on their contents in alkaloids as influenced by these climatic conditions. It is not only the actual *being*, but the *becoming* of the vessels, which we need to know, in order to form clearer conceptions of the formation of the varied products therein contained; and such investigations require to be carried on in connection with the living plant flourishing in a suited place of growth.

The differences in the structure of the *false* and *true* barks are quite evident, not only on examination by the microscope, but to the practised hand and eye of every careful observer, especially when aided by the taste.

DR. KARSTEN'S ANATOMICAL OBSERVATIONS ON THE TRUE AND FALSE BARKS.‡

1. *Cells of the woody fibre* (Bastzellen).—The barks of all *Cinchonæ* increase through a continuous new formation of the woody fibre out of the cambium. They are characterized by spindle-shaped, greatly thickened, ordinarily short, woody fibres, which are arranged in the inner bark (mixed with not thickened, vertically arranged, cylindrical cells, corresponding to the elementary parts of the wood), separated by layers of medullary cells (*Markstrahlzellen*) in radial rows, such as the continuous vegetation of the tropics produces. In the different species of the genus *Cinchona*, the cells which produce the woody fibre (*Bastfaserzellen*) at first contain a brown sap, in which little substances resembling bladders and kernels are swimming, but later are thickened even to the disappearance

* Buchner's 'Repertorium,' 1835, p. 396.

† In his 'Handbuch der Botanischen Pharmacognosie,' Leipzig, 1857.

‡ Karsten's 'Medicinischen Chinارين Neu-Granadas,' pp. 41-49.

of the cavities of the cells, the thickening layer of the daughter-cell are broken by a few fine porous canals, only the youngest ligneous cells next to the cambium have still an open space. In the species of the genus *Ladenbergia* these fibre-cells (*Faserzellen*) are certainly much thickened, but have nevertheless always a more or less conspicuous (*Lumen*) transparent portion: those of the first genus are much shorter and thicker than those of the last, which also have many remarkable porous canals. The cylindrical, and for the most part thin-walled cells which form the tissue, interchanging with the medullary rays in radial layers, on which the woody fibres occur more or less numerous and differently grouped, are found likewise with more or less thickened walling of their concentric skins, in all states of transformation, from these thin-walled cylindrical cells to peculiar woody fibre. Since the medullary rays in the wood, as well as in their peripheric arrangement in the bark in vertical distances, here and there expand themselves into three and four ranges of cells, which appear in the periphery in form of an ellipse, so that the nearest-placed vertically arranged spindle and cylindrical-formed cells of the inner bark are mostly bent somewhat into the form of a bow, the remainder approximating to the normal form to border upon them, the whole tissue takes the appearance of a net in a tangential slice through these changing enlargements of the medullary rays. In the cross-cut we perceive, from the same cause, broader and narrower medullary rays.

2. *Sap-cells* (Saftfasern).—The primary parenchyma-bark of all *Cinchonæ* is separated from the cambium-tissue in the youngest twigs by a row of cells which contain the cinchotannic acid, for the most part in brown-red-coloured, gum-resinous sap. These cells are mostly oblong, and arranged in vertical rows one beside another, and which in many sorts verge into continuous cells, the so-called *vessels* (Gefässe). They are thus separated from the cambium in which these inside-bark cells (*Bastzellen*) are formed, on the inner side of the peripheral part, during the thickening of the woody cells of the central part. As it seems no species of the Linnæan family of *Cinchona* is wanting in these sap-holders (perhaps with the exception of the *C. hirsuta*, R. and P.) in the bark of the youngest twigs, in the *Ladenbergiæ* they are particularly broad, and identified with the vessels called 'milk-sap vessels;' in the *Cinchonæ* they are commonly narrower, and dwindle away almost entirely in many species, so that they are no longer to be recognized in shoots of twenty or more years old. In the tissue of the pith (*Markgewebe*) there are found, in the neighbourhood of the sheath of the pith, likewise these elementary organs; in the neighbourhood of the nodes they are more frequent and greater than in the midst of the internodes. Ordinarily we may say, that in the medicinally powerful barks, with smaller, harder, scrobiculate leaves, these sap-holders are less frequent than in the large-leaved unscrobiculate sorts, like the *Ladenbergiæ*.* Still this is not universally correct, since, for example, in the bark of the *C. glandulifera*, which takes a middling place in respect of medicinal efficacy, and whose lower leaves bear small scrobiculæ in the angles of the veins, we find particularly large sap-holders; they are present even in the more aged, until they are obliterated through the formation of bark in the adjoining tissue. Of the two red barks, which both belong to the richest in organic constituents, the one, containing, according to Delondre and Bouchardat, 1·5 to 1·8 per cent. of Sulphate of Quinine, and called *rouge pâle*, has wide sap-holders, whilst the other, from which these chemists obtained 2 to 2·5 per cent. of Sulphate of Quinine, and called *rouge vive*, shows throughout nothing of these elementary organs.

[Compare our observations on the Red Bark under that head.]

3. *Resin-cells*.—The original spherical cells of the primary bark, which later on is separated from the part of the inner bark which contains cells of the woody fibre (*Bastzellen*) by means of the sap-cells or layer of sap-fibres, are then horizontally arranged, and one finds, instead of the woody fibre (*Bastfasern*), some of these cells, or more of them together, groups or layers forming, with strongly porous thickened walls, and filled with a very similar resinous sap to that which the sap-holders contain. The thick-walled woody cells are found in the inner bark of the *Cinchonæ*, as was said, stronger formed—that is to say, more complete and proportionally thicker—than in the *Ladenbergiæ*, contrariwise these porous thickened walls of the outer bark are much stronger developed than amongst the good *Cinchonæ*.

Among some *Ladenbergiæ*, for example the *macrocarpa*, they form almost complete layers within the cork, interchanging with thinner layers of parenchymatous cells; they are found especially in the species of the genus *Cinchona*, vertically arranged and united in bundles, comparable to the woody fibre bundles of the inner bark of the *Cinchonæ*;† whilst amongst these, and certainly in the cross-cut, these resin-cells seldom occur or fail altogether in the more powerfully medicinal barks, for example, the Red Barks, in the *Calisaya* very seldom, amongst others more frequently, but never formed into a mass, as amongst the *Ladenbergiæ*. Still one cannot draw a universal rule

* Compare the *C. ovata*, Pavon.

† These vertically-arranged resin-cells are often singularly like the thick, short, woody fibres of the good *Cinchona* bark, but are distinguished at once by the greater *Lumen* of the cell, and the larger porous canals of the walls.

from the presence of these resin-cells, since these are often present in considerable number amongst medicinally powerful barks,—for example, in our orange-coloured bark, where in the fracture the dark lines form beneath the cork. These elementary organs of the outer bark, which stand in relationship with the cork and the bark, whilst these become thrust off through the formation of bark, also in the increased parenchyma of the inner bark, between the woody fibres, with which they subsequently become extinct. They are formed also in tissues, in which apparently they disappear contemporaneously with the formation of the organic bases.

Also the remaining horizontally arranged not thickened bark-cells, standing near to the layer of cork, fill themselves up in some kinds, and in certain places of growth, with a similar dark-coloured sap, through which, on the broken surface of the dry bark, a shining dark layer becomes conspicuous,—the so-called resinous circle, which has been taken advantage of to distinguish, by its presence or absence, the different barks, more particularly the Peruvian grey barks. Yet since this richness in resin is found first in old barks, and, as it appears, also preferentially in certain localities, so the discrimination of barks by this means does not always agree with their derivation, although this circumstance may very well serve as a finger-post. After the outer bark is thrown off through the bark-formation, these thick-walled cells are found also in the increased parenchyma of the inner bark between the woody fibres.

4. *Crystal-cells* (Kalkzellen).—Some cells, both of the inner and outer bark, and of the marrow (*Mark*), especially in the younger tissue containing starch, are filled with little corns of oxalate of lime, whose presence, nevertheless, does not appear to be constant, apparently changing as the presence of organic bases changes with the alteration of the nourishing contents.* They make their appearance in genuine *Cinchonæ*, as also in the *Ladenbergiæ*; yet universally seldomer in the first, and also less amongst the hard-leaved than the soft-leaved kinds, therefore a sign of inferiority. In the *Ch. Maracaibo*, from the *C. Tucujensis* and the *Ch. Cusco* (from the *C. pubescens*, Fl. Per.), they are very frequent.

5. *Cork and Bark*.—The outer bark layer of all *Cinchonæ* becomes lost with age through the continuous bark-formation, and even the woody layer of the inner bark becomes changed into bark whilst new grows on the inner side. Among the different sorts of *Cinchonæ*, the bark forms, owing to the situation, in very different ways, whilst amongst some the production of the parenchymatous cork, amongst others that of the so-called spongy cork, consisting of radially arranged cells, strung together one by another, also by others the cork consisting of table-formed cells of the periderma or flat cork, prevails, which last, when it penetrates the tissue of the bark or of the spongy bark, forms the so-called *bark-scales*. For many sorts of *Cinchona*, which are particularly strongly allied to certain climatic conditions for their flourishing, the form of the cork and bark-formation afford a characteristic mark, striking the eye, for example, in the bushy sorts, which grow on the sunny grassy slopes of the Andes of Peru, freely or beside low bushes: also in the *C. Condaminea*, Humb., *Bonplandinea*, Kl., and the *C. Calisaya*, Wedd., which, according to the observation of botanists in the dales of the mossy mountain-range of Bolivia, rise to a height of 5,000 feet, surpassing all the neighbouring trees of the forest. For these sorts, surrounded frequently by a dry air, but interchangeably wetted through passing clouds, a frequently-repeated formation of the flat cork appears to be the rule: this is brought about through the alternation of the drying up and tearing of the outer bark and cork layer with the moistening and swelling up of the fundamentally free-laid parenchyma, which immediately becomes changed into cork-tissue, on healing of the cleft wound. If one takes away the cork layer, the healed clefts are distinguishable as flat furrows in the under layer. The *C. lancifolia*, growing in the continuously damp atmosphere of the cloud region, is, on the other hand, characterized by a stronger formation of parenchymatous cork, and less regular clefts and exuberances of the flat cork. I cite in illustration of the *C. corymbosa*, that I have observed both sorts of bark-formation,—in the damp shady thick forest the cork-formation on the lower twigs and stems, whilst the smaller trees growing on the forest edge on dry ground repeat the bark-formation of the *Calisaya* and the *Condaminea*.

* The increase of the cells which contain the oxalate of lime, is frequently something more prolonged than that of the neighbouring tissue, so that their walls remain thinner, and we observe also in the grown tissue at times the cells lying over one another in vertical layers of two to four, in spherical form, on the inner side of the mother-cell, whilst the neighbouring equally large cells occur with their walls pressed one to another, and appear in the common polyhedric form which many anatomists consider as originating from simple partition-walls.



CHINCHONA PURPUREA.

CHINCHONA PURPUREA, foliis oppositis, petiolatis, oblongo-ovalibus ovatisque, purpureis, integerrimis, nitidis; floribus paniculatis, subcorymbosis. *Flor. Per. vol. ii. p. 52. ic. 193. Cascarillo morado*, Ruiz, Quinologia, Artic. 5. p. 67. *Arbor* 4-orgyalis, comâ frondiusculâ, patulâ. *Truncus* solitarius, erectus, teres, parum crassus. *Cortex* fuscus, lævis, intus dilute fulvus, amarus, acidulus, non ingratus: virtute mediocri febrifugâ pollet, et in febris propinatur. *Rami* teretes; juniores quadrangulares, glabri, foliosi, sulcati. *Folia* opposita, petiolata, patentia, plana, ut plurimum tripalmaria, oblongo-ovalia ovataque, integerrima, supra nitida, subtus venosa, purpurea; *tenera* interius pubescentia; *adulta* utrinque glabra. *Petiolî* semiteretes, pollicares, purpurei. *Stipulæ* interfoliaceæ, supra-axillares, oppositæ, basi connatæ, ovato-cordatæ, obtusæ, adpressæ, deciduæ. *Panicula* terminalis, foliosa, subracemosa, magna. *Pedunculi* brachiati, longi, tetragoni, compressi. *Flores* corymbosi, breviter pedicellati. *Pedunculi* et *pedicelli* bracteolis subulatis deciduis stipati. *Calyx* minimus, obscure purpureus. *Corolla* extus leviter tomentosa. *Tubus* dilute ruber. *Limbus* supra hirsutus, albus, infra purpurascens. *Antheræ* lineares, basi bifidæ, inclusæ. *Germen* tomentosum. *Capsula* oblonga, angusta, decemstriata, rubro-fusca, a basi ad apicem hians. *Semina* fulva, alâ lineari utrinque acutâ lacerâ fulvescente cincta.—*Habitat* in Andium montibus imis, nemorosis, et nocte frigidiusculis passim ad Chinchao, Pati, Muna, Isatunam, Cassapi, Cassapillo, et Chihuamcala tractus. *Floret* a Maio ad Septembrem. *Vernacule*, Cascarillo bobo de hoja morada. *Observ.* Hanc speciem in Pati montibus, mense Julio, anno 1780, primum invenimus.—*Pavon, MS. Nueva Quin. sub sp. 14.*

This species is described by Poeppig as a tree of considerable height and circumference, which is easily distinguished from all the allied members of the family by the circumstance that its very large and membranaceous leaves are covered on the under side with very prominent violet-coloured veins, which in the early stage of the leaf are so near together, that the whole leaf presents a similar tint. The bark is, according to this author, exceedingly bitter, but is nevertheless not gathered except to mix with the better sorts. It is called *Cascarilla boba colorada*, and under the warm sky of Maynas becomes entirely useless. The specimens of this bark brought home by Poeppig were examined by Dr. Reichel, who pronounces it to be the Huamalies bark of trade. In this identification I am, after full examination, disposed to concur, and I am glad to be able to do justice to the correctness of Dr. Reichel's view of the matter, as I think it exact, if the Huamalies of Van Bergen's collection is taken as the standard. This type of bark has now almost entirely disappeared from trade; its peculiar characteristics are therefore more difficult to identify, and it must be understood that the Huamalies bark, of which Pereira speaks,* under the name of *Rusty Crown Bark* of English commerce, is the produce of a totally different tree, the *C. Chahuarguera* of Pavon. I must also add, that my specimen of the bark of this species, from Pavon's collection, does not, from some cause,† satisfactorily bear out the identification. I am therefore thrown back on Poeppig's information, in which there is scarcely a possibility of mistake, as his specimens were carefully gathered, abundant, and examined by Dr. Reichel on their arrival.

* 'Materia Medica,' vol. ii. part 2. p. 1635.

† Probably from an exchange with that of *C. pubescens*.

To this origin, then, I refer the following specimens in my possession, which may all proceed from the same tree, although differing in some respects at first sight.

1. Sections of a young tree of Huamalies bark, from Bergen's collection, given me by Reichel.
2. Huamalies bark, met with in commerce at Hamburg in 1824, from Bergen's collection, given me by the same gentleman.
3. Bark of *Chinchona purpurea*, R. and P., from Pavon's collection, given me as above, and not so different as mine from the aspect of young Huamalies bark.
4. China Huamalies, given me by Martiny.
5. China Huamalies, from Winckler, by favour of Pereira.
6. Huamalies bark, given me by Batka.
7. Huamalies bark, from Bergen's collection, given me by the Pharmaceutical Society.
8. *Cascarilla boba colorada*, *C. purpurea*, R. and P., *Cuchero*, as gathered and determined by Poeppig in 1829,—from the collections of Reichel and Martiny.
9. "Huamalies ferrugineux, gris terne, blanc A, blanc B, rouge, rougeâtre, mince et rougeâtre," given me by Guibourt.

I cannot find any resemblance in the Huamalies bark to that of *C. pubescens*, gathered by Dr. Weddell, and of which he has kindly given me a specimen. The comparison of the coloured representations of this in tab. xxix. of the 'Histoire Naturelle des Quinquinas,' with those of Von Bergen's Huamalies, in his tab. v., will well illustrate this difference; but it must be understood that the discrepancy extends much beyond the outward appearance, and affects equally the chemical and microscopical structure; no two barks could well be more unlike; so that if we really have the *C. purpurea* represented in its produce by the Huamalies bark, it must follow that the *C. pubescens* is specifically different, unless (which does not appear probable) the characteristics of the barks diverge entirely from each other, whilst the plant remains the same.

My examination of the few parcels of Huamalies which have met my notice in commerce, coincides with records of experiments collected by Van Bergen in showing a bark particularly rich in Cinchonine, and contrasted in this especially with the aricine-producing *C. pubescens*, var. *Pelletierana*, Weddell.

My own belief is, that there are several varieties in this connection, of which we probably know only a portion, and that it is not impossible that there may be some slight difference even between the sorts of Pavon and of Poeppig. I have added no synonyms to Pavon's description, as I feel quite uncertain on the subject, though I think the present plant is identical with Hayne's *C. purpurea*.* An inspection of the very rich collection of Sir W. J. Hooker shows what varied plants are labelled *C. purpurea* by different collectors, so that one is ready to suppose that the circumstance of the purple colour of the under side of the leaf has been too exclusively dwelt upon by many, without sufficient regard to other characteristics. For this is a feature in a greater or less degree common to several species, as noticed by Weddell, in his description of the *C. Boliviana*. Even the *C. succirubra* has been marked in pencil *C. purpurea*, in default of information of its true character.

* Dr. F. G. Hayne's 'Darstellung und Beschreibung der in der Arzneikunde gebräuchlichen Gewächse,' von Dr. Klotzsch: Berlin, 1843. 14 Band, Heft 2, Plate XIV.

By far the most interesting to me in this connection are some botanical specimens* collected by a German botanist, W. Lechler, in 1854, in the neighbourhood of San Govan, and to one of which he has attached the name "*Cascarilla morada* et *zamba morada* incolarum." One of these, concerning which he seems to have hesitated whether he should regard it as a new species or as a variety, possesses the external characteristics which mark the very valuable sorts of bark, especially in its small and beautifully formed capsules, as also in its delicate leaves. It is not improbable that this may be the species producing the finer Carabaya Bark, the *zamba morada*, or *dark purple*, whilst the *morada ordinaria* may proceed from the *C. rufinervis* and *C. erythroderma* of Weddell. At all events, the "Carabaya Bark," especially that from the district of Marcapata, bears so strong a resemblance to the "Huamalies Bark," that it is difficult to believe there can be any very wide divergence between the trees by which they are produced. This "Carabaya Bark"† was a moderately good and productive sort, of which a large quantity was imported about the years 1847 to 1853; but the distance from the coast occasioned expense in the transport, and consequent loss to the dealers, so that it has ceased to come. The present Plate has been delineated from specimens at Madrid, marked "*C. purpurea*, *Icon.* 193, *Casc. boba de hoja morada*, de Yucuman, Pati, Yamuna, 1787, Peru, which agree with some similar specimens in the British Museum. Those at Madrid appear to be very complete, and are identified with the form represented in plate cxiii. of vol. ii. 'Flora Peruviana.'

* To which are attached the following descriptions:—

No. 1. "W. Lechler. Pl. Peruvianæ, Ed. R. T. Hohenacker, 2342. *Cinchona purpurea*, R. P., Schl. *Cascarilla morada* et *zamba morada* incolar. In montibus asperis prope San Govan, Jul. m. 1854." [Cordate leaves; capsules shed all their contents easily.]

No. 2. "W. Lechler, etc., 2347. *Cinchona Lechleriana*, Schl., n. sp. vel potius var. *C. purpurea*, R. P. microcarpa et brevi stylo, Schld. In montibus prope San Govan, Jul. m. 1854." [Apparently a very fine bark.]

No. 3. "W. Lechler, etc., 2413. *C. pubescens*, Vahl (*C. cordifolia*, Mutis, var. *pubescens*, Hayne), Schld. In montibus prope San Govan, Jul. m. 1854." [This last is probably identical with our *C. purpurea*.—Ed.]

† Described in the 'Quinologie' of Delondre and Bouchardat, p. 26, pl. ii.

CHINCHONA PUBESCENS.

CHINCHONA PUBESCENS, foliis ovatis, basi elongatis, subtus pubescentibus, capsulis cylindricis. *Vahl in Act. Havn. s. 1. p. 19. t. 2. Mill. Dict. Mart. Lambert, 'Description of the Genus Chinchona,' p. 21. pl. 2.*
Rami superne pubescentes. *Folia* petiolata, spithamæa, palmam lata, obtusa, basin parum per petiolum decurrentia, tenera, venosa, subtus nervis pubescentia. *Petiulus* bipollicaris, pubescens, subtus convexus. *Panicula* terminalis, brachiata, pubescens. *Pedunculi* partiales, bis trifidi. *Pedicelli* brevissimi, uniflori. *Bracteæ* minutæ, ad basin pedicellorum. *Calycis* margo superus quinquedentatus; dentibus minutis, ovatis, acutis. *Capsula* cylindrica, pollicaris, utrinque parum angustata. *Pavon, MS. Nueva Quin. sub sp. (non origin.) 50.*

I have introduced the above as *copied* by Pavon from Lambert's 'Description of the Genus Cinchona,' showing that he must have been at length convinced of the propriety of recognizing the present species as separate from the preceding. At first it would appear to have been regarded as a variety of the *Cinchona purpurea*, or possibly as identical with it, but it is probable that Ruiz and Pavon were imperfectly acquainted with the plant, and it does not appear to be represented by any good specimens in the herbarium of Pavon. I can only refer to one doubtful example in the British Museum, marked "*C. purpurea, sp. nova edita Fl. Per.; in montibus Huanuci.*" This plant is totally distinct from the *C. purpurea** of the same collection; but it seems to me to have a very close analogy with a specimen kindly given me by Dr. Weddell, and of his collecting, marked "*Cinchona cordifolia*, Mutis, Vallée de Tambopata, Prov. de Carabaya, Pérou." Nevertheless, I do not look upon the two as identical, but regard the *C. cordifolia*, Wedd., as the Bolivian form of the Mutisian species. This last, however, has rather a different character from the *C. cordifolia*, Mutis, as gathered by Karsten, and given me by this botanist, which also the reader will find figured in plate viii. of the first part of the 'Specimina Selecta' of this author. The beautifully heart-shaped leaves entirely justify the epithet conferred by Mutis, and in their texture, as well as in the arrangement of the delicate venation, present an aspect varying considerably from those which have met my eye, in the different collections, under the name of *C. cordifolia*, and of which some would perhaps range better under *C. pubescens*. The capsules of the *C. cordifolia*, Mutis, as described and figured by Dr. Karsten, are most characteristically contrasted with those of the specimens above mentioned. The long-fruited variety of the *C. cordifolia* sent over by Don Restrepo, increases the difficulty of the diagnosis of the two species: I should have thought this an intermediate link between the two; but the bark, as sent over by Restrepo, and now in my possession, so much resembles that of the short-fruited variety, and differs so much from the bark of the *C. pubescens*, that I remain in doubt.† Those of the *C. pubescens*

* Figured in plate xciii. of the 'Flora Peruviana.'

† The following remarks on the *C. cordifolia* of New Granada, were sent, together with specimens, by Don J. M. Restrepo, under date "Bogotá, 13th December, 1850:"—

"*C. cordifolia*, No. 1.—The fruit of this species is long, yellow, and abundant; it is found in the forests under a higher temperature than the *lancifolia*. This tree is more abundant and thicker than the *lancifolia*.

"*C. cordifolia*, No. 2.—There appears to be some difference between this species and the former. The fruit is smaller, and of a black colour. The fibres of the leaves have but little red, rather inclining to green."

The bark of these two varieties differs very slightly in appearance. It is described as very abundant, but varying in its products with the soil on which it grows.

appear* to be cylindrical, with little remaining indications of calyx or ribs, and approaching closely to those of *C. magnifolia*.

The product of this species is the bark described under this head by Dr. Weddell, and of which this gentleman has favoured me with a specimen. It is almost useless in commerce. I have known parcels of this sort, exactly as figured in tab. xxix. fig. 22, 23, imported as Calisaya bark, although the want of resemblance might strike the most careless observer. These parcels acquired the name of White Calisaya, and were rejected as spurious. A specimen gave me on examination much kinovic acid, resin, a considerable proportion of soluble yellow colouring matter (which is still more abundant in the *C. Pelletierana*), also nearly three parts of alkaloid in a hundred of bark, of which two-thirds appeared to be cinchonine and cinchonidine, and the remainder, although nearly as soluble in ether as quinine, gave a very small proportion of crystalline salt, composed partly of quinine, partly of cinchonidine.

For a full description of the bark of *C. pubescens* I refer to Pereira,† but with this remark, that he too much associates this with the bark of *C. Pelletierana*, a very different sort, chemically considered, although possessing many features in common. Messrs. Delondre and Bouchardat have done better in their ‘Description des Quinquinas,’ by separately classing them as the *Quinquina jaune de Cuzco* and the *Quinquina brun de Cuzco*. The former is the bark of the *C. Pelletierana*, in which they found the characteristic product of aricine; the last is that of our *C. pubescens*, from which they profess to have obtained forty centigrammes‡ of Sulphate of Quinine per kilogramme of bark. Plate 19 of the same work contains very characteristic and well-executed representations of both these barks.

According to Delondre,§ the *C. pubescens* is found in the forest of Cuzco, almost always intermingled with the *C. Pelletierana*. The external surface is uniform, of a sombre brown; the internal face rather less dark; the fracture is clean, with fine and very close fibres; resinous below the very fine epiderm, to which adhere greenish-white pellicules. The bitterness is very feeble, and developed with difficulty, styptic, and with a disagreeable taste.

The *Cascarilla colorada del Cuzco*|| is a totally distinct bark, the product of the *C. scrobiculata*, H. and B., a species most strikingly and characteristically different from all those which are comprehended in my descriptions.

The anatomical examination of the *C. pubescens*, as given by Weddell in his ‘Histoire,’ shows us a plant adapted to a region of intermittent vegetation rather than to the climate which is congenial to the quinine-producing *Cinchonæ*, and the woody fibres are coarse and strongly grouped together. In the very aspect and feel of the bark we may discern an approach to the *Cascarillos bobos*; and the microscopical examination shows not only wide open lacunæ, but also many of the

* See Lambert’s ‘Description,’ pl. 2; also the diagnosis above.

† ‘Materia Medica,’ vol. ii. part 2, pp. 1650–1652.

‡ The weight which I obtained from experiments on a small portion of bark was about the same, but the quinine proved to be, as noticed above, impure.

§ ‘Quinologie,’ p. 39.

|| See Delondre and Bouchardat’s ‘Quinologie,’ pl. 3, and p. 26; also Weddell’s ‘Histoire,’ pl. xxviii. fig. 5–8.

fibres are entirely of the sort figured by Schleiden* as marking the allied *Ladenbergiæ*. The botanical, chemical, and anatomical examination alike show a plant standing near the confines of the genus *Cinchona*, and almost on the verge of the *Ladenbergiæ*.

The characteristics of the *C. cordifolia*, Mutis, are found also to some extent in the specimens I have from Dr. Weddell of his *C. cordifolia*, gathered in Bolivia. Both are distinct from the bark of the *C. pubescens*, and also from that of the *C. purpurea*, Pavon, as gathered by Poeppig, and now in my possession.

* 'Pharmacognosie,' p. 220.



CHINCHONA ERYTHRANTHA.

CHINCHONA ERYTHRANTHA, foliis oppositis, petiolatis, lanceolato-ovatis, acuminatis, undulatis, nervosis, paniculâ diffusâ. Arbor 3–4-orgyalis. Truncus erectus, solitarius, ramosus. Coma frondosa, ramosa. Rami diffusi, patentés, tetragoni. Folia opposita, petiolata, lanceolato-ovata, acuminata, undulata, nervosa, venosa, nervis pubescentibus, integerrima, parum coriacea, marginibus revolutis, utrinque glabra. Foliola superiora, subtus hirsutiora. Petioli subteretes, basi incrassati. Stipulae interfoliaceae, oppositae, supra-axillares, ovaes, sessiles, cauli appressae, subtus pubescentes, obtusae, integerrimae, deciduae. Pedunculi communes, axillares terminalesque, tetragoni, paniculati, diffusi, hirsuti, bracteolis duabus oppositis lanceolato-subulatis ad basim suffulti. Partiales pedicellique aliis bracteolis minoribus, solitariis, subulatis, in medio et ad ejus basim inserti pubescentesque. Calyx campanulatus, laciniis quinque, lanceolatis, acuminatis. Corolla extus pubescens, laciniis intus villosissimis, villis albicantibus, rubra, laciniis revolutis. Antherae pallidae, lineares. Capsula oblongo-linearis, utrinque sulcata, basi hians, bivalvis. Receptaculum lineare. Semina utrinque lanceolato-acuminata, latea.—Habitat in montibus Jaen et Huayaquil. Floret Junio, Julio, et Augusto. Observ. Erythrantha, a florum rubro colore, dixi. Pavon, MS. Nueva Quin. sub sp. 17.

We have no information in the above description which could lead to the identification of the bark of this species. The specimen at Madrid, from which the drawing is taken, is marked, first, “*Casc. sin nombre, esta es diferente especie que la Cascarilla serrana o acanelada y pata de Gallinazo, sp. nova de Huayaquil, no. 583, ic. 737, 1805.*” The name (*Ch. erythrantha*) has been added probably at a later period.

From the above intimation it may be surmised that the bark is not much unlike the *acanelada*, or cinnamon-coloured bark, and perhaps gathered with it. For further particulars of the above bark I must refer the reader to the description of *C. coccinea*.



CHINCHONA PALTON.

CHINCHONA PALTON, foliis oppositis, petiolatis, ovalibus oblongisque, acuminatis, undulatis, glabris, pedunculis paniculatis, capsulis ventricosis.

Arbor 4-orgyalis et ultra. *Truncus* solitarius, erectus, teres; comâ frondosâ ramosâ, cortice fusco, maculis albicantibus, rimis transversalibus longitudinalibusque: sapore amaro non ingrato, et in medicinâ usurpari debet. *Rami* parum compressi, striati, subteretes, dilute rosacei. *Folia* opposita, petiolata, ovalia oblongaque, undulata, integerrima, glabra, nitida, obtuse acuminata, nervosa, leviter venosa, glandulis subrotundis subtus concavis circum marginem villis minimis albicantibus ad nervorum ortum insertis, supra prominentibus. *Petiol* teretes, superne parum compressi, purpurei, uti nervi centrales foliorum. *Stipulae* duæ, oppositæ, interfoliaceæ, supra-axillares, erectæ, cauli appressæ, sessiles, integerrimæ, nervo centrali prominente apice obtusæ, marginibus retroflexis deciduæ. *Pedunculi communes* axillares terminalesque, paniculati, foliosi, striati, subtetragoni, foliolis lanceolatis ovalibusque; *partiales* bracteolis duabus, oppositis, patentibus, lineari-subulatis, ad basim insertis. *Pedicelli* breves, bracteolis minimis ovatis concavis subulatis ad basim et in medio insertis. *Calyx* pubescens, dilute purpureus. *Corolla* pubescens, purpurea, laciniis parum reflexis superne villosa-tomentosis, villis albicantibus persistentibus. *Antheræ* lineares, fauce inclusæ. *Stigma* supra faucem exsertum. *Capsula* ovalis ventricosaque, calyce persistente laciniis in fructu maturo patentibus reflexis, bilocularis, bivalvis; valvulis basi dehiscentibus, sulcis duobus utrinque oppositis.—*Habitat* in collibus Yunza, prope Mazana Maca, rus Lojá Provinciâ. *Floret* Junio, Julio, et Augusto. *Vernacule*, *Cascarilla con hojas de Palton*.^{*}—*Pavon*, MS. *Nueva Quin. sub sp.* 36.

The bark of this species (according to Pavon's 'Observation' below) offers much resistance to the knife when it is stripped from the tree, on account of the tenacity with which it adheres to the wood. On being separated it acquires a colour like that of *Carthamus tinctorius*, or Roman Saffron; and after the cutting of the bark it takes a colour much resembling the "Red Bark," yet it is not so solid, nor of so agreeable a bitter.

These particulars accord sufficiently well with the general features of the barks which commercially are called "West Coast Carthagena," to lead to the supposition that this may be in part the source of that sort. This view is confirmed by Pavon's specimen of the Palton bark in my possession. It consists of quills of a brown-orange substance, and structure internally fibrous, with a white micaceous epidermic layer covering the russet-red derm, and, superimposed on this, suberous layers with longitudinally furrowed surface of grey aspect; the small quills exhibiting transverse clefts.

It corresponds, as closely as can be expected, when the different size of the quills is taken into the account, with the bark sent me by Dr. Wittstein as that from which he obtained the new Cinchonidin which he has described in his 'Vierteljahresschrift,' and from which Dr. Herapath succeeded in obtaining a peculiar iodo-sulphate. The bark Dr. Wittstein calls *China pseudo-regia*,[†] and

^{*} *Observatio*.—"Esta especie de Cascarilla se resiste mucho al cuchillo cuando se extrahe la cortezon por estar muy adherida al leño. Luego adquiere un color amarillo como el que presta el *Carthamus tinctorius*, ó sea el Azafran Romin; y despues de secar la corteza, toma un color muy parecido á la *Cascarilla colorada*; pero no es tan solida, ni de un amargo tan agradable."—*Pavon*, l. c.

[†] Wittstein, 'Vierteljahresschrift für praktische Pharmacie,' 1856, p. 513.

describes as holding an intermediate place between *China regia* and *China rubra* in regard to its taste and colour. This name is however objectionable, inasmuch as it has been before applied to very different bark,* and also that it is not likely to be confounded with the *China regia*, and moreover is well known in English commerce as coming under the designation of "Carthagena bark," although it is very evident, from the ports of shipment, that it has no sort of connection with that place. It is exported ordinarily by way of Guayaquil, and I have reason to think it is gathered not far from the district marked out by Pavon as the habitat of the *C. Palton*.

I have found in such bark (the product, as I suppose, of the present species) the following proportions of alkaloid:—Cinchonidine (*Pasteur*) and Cinchonidin† (*Wittstein*), 1·34; Quinine, 0·71; total, 2·05 per cent. It must be regarded consequently as an efficacious bark.

The microscopical examination of Pavon's specimen of Palton bark discloses a thick layer of white micaceous suberous coat, formed of oblong cells arranged in parallel lines, beneath which there appear in the bark itself an unusual number of *resin-cells* filled with pink substance, thus giving the reason for the orange, or perhaps rather saffron colour of the derm.

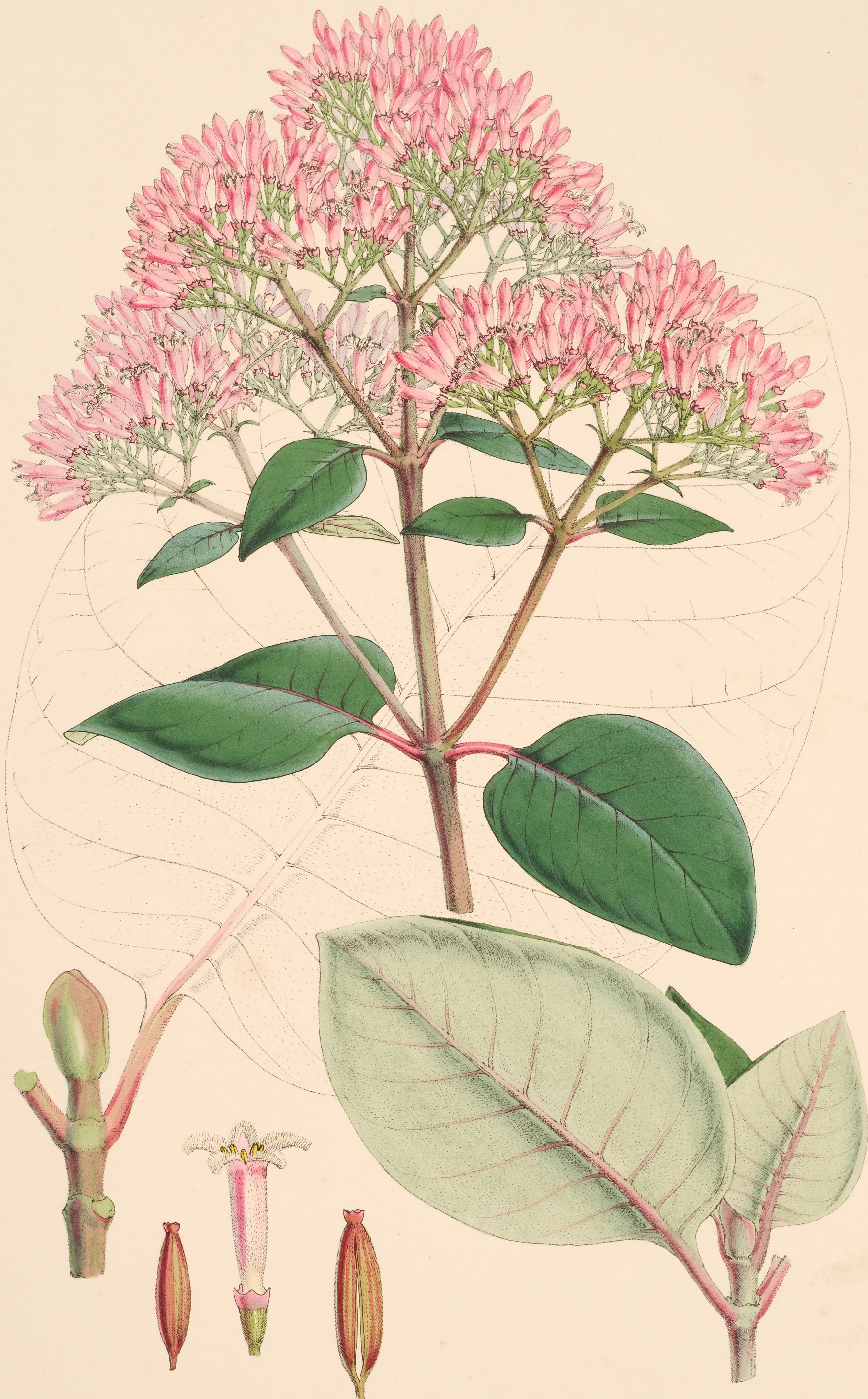
The taste of the above specimen is decidedly but not unpleasantly bitter, and it gives an abundant pink sublimate by heat. It resembles the small quills of the sort of "West Coast Carthagena" bark above referred to.

* The *China rubiginosa* of Winckler bears the name of *Cortex Chinæ pseudo-regius* of Dr. Julius Martiny, according to a specimen (No. 18) in the Museum of the Pharmaceutical Society, London. The origin of this bark is yet unascertained.

† The Cinchonidin of Wittstein differs from that examined by Leers in its atomic composition, which is not, however, absolutely determined. Not improbably the difference will be found to be its containing one atom less water in combination. It is much less soluble in ether, alcohol, and in water; but its salts, on the contrary, as examined by Crawford ('Vierteljahresschrift,' 1858, p. 537), appear, with the exception of the tartrate, to be much more soluble.

Dr. Herapath found (Quarterly Journal of the Chemical Society, July, 1858, p. 132) that the Cinchonidin of Wittstein differs from that of Pasteur in producing an iodo-sulphate, having a deep yellow or sienna-brown transmitted light and an olive-brown or dull reddish-brown reflected tint.

This alkaloid is not confined to the bark of the present species, but is also found abundantly in many specimens of Pitaya bark.



W. R. H. del. et lith.

CINCHONA LUTEA. Pavon.
Cascarillo amarillo de Ynta y Chito.

W. West imp.

CHINCHONA LUTEA.

CHINCHONA LUTEA, foliis oppositis, petiolatis, ovalibus ovatisque, subrotundis, acuminatis, pedunculis racemosis.

Arbor 12–13-orgyalis. *Truncus* solitarius, erectus, teres, comâ ramosâ, parum frondosâ. *Cortex* asper, maculis albicantibus, ab invicem pallescentibus, aliquando rimis transversalibus longitudinalibusque, sæpe nullis, sapore valde amaro, acidulo, viribus præcellentibus et in medicinâ magno uso fit. *Rami* tetragonales, duobus sulcis oppositis, pubescentibus, tomentosis, rubicundis. *Folia* opposita, petiolata, ovalia, subrotunda ovataque nonnulla obovata, acumine brevi, integerrima, subtus magis pubescentia, nervosa venosaque, pubescentia pallescente, venis nervisque roseo colore, basi decurrentia, marginibus retroflexis, nonnulla undulata. *Petioles* teretes, breves, basi incrassati, pubescentes, canaliculati, rosacei. *Stipulæ* duæ interfoliaceæ, sessiles, oppositæ, supra-axillares, basi subtangentes, subrotundæ, acumine brevi, integerrimæ, cauli appressæ, subcordatæ, marginibus revolutis, viridi-roseo colore, deciduæ. *Pedunculi communes* racemosi, axillares terminalesque, tetragonales, tomentosi. *Foliolis* floralibus oblongis, pubescentibus, obtusis, oppositis, petiolatis. *Partiales* oppositi, tomentosi. *Pedicelli* tomentosi, teretes, breves. *Bracteæ* ad pedicellorum basim et in medio lanceolato-subulatæ, solitariæ, concavæ, pubescentes, insertæ. *Flores* alii pedicellati, alii sessiles. *Calyx* rosaceus. *Corolla* extus pubescens, laciniis intus villosis, villis albicantibus longis, rosacea. *Antheræ* luteæ, lineares. *Capsula* oblongo-linearis, rubicunda, striata, pubescens, bivalvis, *valvulis* basi hiantibus, capsulæ nonnullæ incurvatæ. *Receptaculum* lineare.—*Habitat* in *Ynta Otavolo* ditione, in *Cocanihuas* viâ, et in Malbucho, locis altis, frigidis, et in Chito, Jaen Provinciâ Quitensi. *Floret* Aprili et Maio. *Vulgo*, *Cascarilla amarilla de Ynta* et *Chito*. *Obs.* 1. Eadem species est *la Cascarilla amarilla de Chito* et *de Ynta*.^{*} *Obs.* 2. Ex arborum amputatione succus lacteus profluit.—*Pavon*, *MS. Nueva Quin. sub sp.* 20.

This plant presents much resemblance in the form of the leaves to the *C. cordifolia* of Mutis, as the same is represented in plate viii. of the ‘Specimina Selecta’ of Karsten, and exhibited in dried specimens of the plant given me by that gentleman. It nevertheless appears to me to be a distinct species, not only by the best comparison I can make of the capsules and of the flowers, but also by the great difference in the structure of the bark of the two plants.

The present species of Pavon seems to me to form, with several others, a group distinguished by the prevalence of a yellow colour in the bark itself. This is exceedingly remarkable in that of the *C. Peletierana*, the *Quina amarilla* of Carabaya,† which produces only aricine; but on account of the above feature, is valued by some druggists, to whom the appearance of the powder is more important than its chemical composition. Indeed, the whole of this group of trees are amongst the less valuable in the family of the *Cinchonæ*, although the term “Yellow Bark,” first given by Mutis to his *cordifolia* bark, has come to be applied most erroneously to the product of the *C. Calisaya*, and consequently to indicate the best sort in commerce.

The coarse and rigid structure of the bark is also a distinctive mark of these inferior sorts, which thus vary from those of greater value, and in their ligneous character approach the Pseudo-quinas. When examined by the microscope, it is evident that the cortical fibres occasionally depart from

^{*} “Solo se observa una pequeña variacion de corto momento, que no puedo formar nueva especie, y la causa proviene de la localidad. Esto es mi dictamen.”—*Pavon*, *l. c.*

† Wedd. ‘Histoire,’ p. 56.

the normal structure belonging to the *Cinchonæ*, such as is well described by Schleiden,* and assume the appearance which he has represented† as proper to the Cascarilla tribe of Weddell. I notice these in transverse sections of *C. lutea* and also of *C. decurrentifolia*, Pavon. They prevail very strikingly also in some *blanc fibreux de Jaen*, from Guibourt, and rather less so in *Jaen pallida* (*C. lutea*), from Winckler. I do not notice them in a specimen of *C. pubescens* given me by Weddell, but they are very distinct in the bark of the *C. Pelletierana*, as found in commerce. These barks also show large and for the most part empty lacunæ, or, in other cases, milk-sap cells, in which the sap yet remains dried and shrunk.

Dr. Weddell says, when speaking of the *lacunes analogues aux vaisseaux laticifères* (which, I presume, are the same as the *Milchsaftzellen* of Schleiden):—"Le liquide gomme-résineux qui flue de ces conduits ouverts sur une écorce fraîche, m'a semblé être plutôt astringent qu'amer. Dans le genre Cascarilla ils sont beaucoup plus développés que chez les Cinchonas." We have thus a further evidence of the tendency in several species to vary from the normal type of the family, diverging a little towards the *Pseudo-quinæ*; for the abundant production of Kinova-bitter is as much a feature of these latter as that of the peculiar alkaloids is of the *Cinchonæ*.

This distinctive yellow colour almost entirely supersedes the cincho-tannic acid in the aricine-producing *Cinchonæ*, the *C. Pelletierana*, *C. villosa*, *C. decurrentifolia*, *C. microphylla*, etc., and in greater or less degree in others of the group. It is described by Winckler in the *helle Jaen China*, that is to say, in the product of the present species, as a yellow resin, by which the purification of the alkaloids was so unusually hindered, that from six drachms of the rough he could only obtain six grains of the pure alkaloid.‡ The fact is, that this yellow colouring matter takes the place occupied by the cincho-tannic acid in the finer *Cinchonæ*, and constitutes a similar link of connection between the kinovic acid and the alkalies. By exposure to the light and air it deepens into a fine orange tint, as the cincho-tannic acid does into the fine cinchona-red. This yellow colour adheres to the kinovic acid, as well as to the alkalies, with an almost incredible pertinacity. If the nature of things were considered in forming the nomenclature of the barks, it is the above group which would stand forth as pre-eminent above the rest in this feature, and would be known as trees producing yellow bark.

This tree furnished the barks called in Pavon's time *the Yellow barks of Chito and of Ynta*. Chito is an obscure place not far from Jaen, and the bark in Pavon's collection is so entirely the same with the pale Jaen bark (*helle Jaen China*), which I have from Winckler, that I have no hesitation in considering them identical. Ynta is in the district of Otavolo, according to Pavon, that is to say, near the Equator, and about three hundred miles further north than Chito; and it is not a little remarkable that the section of the bark of this northern variety shows a close approximation to the *C. cordifolia* of Mutis, as found in New Granada, at about the same distance north of the Line that the Jaen bark grows to the south of it. These "Yellow Barks" had not any connection with the *King's Yellow of Loja*, or with the Yellow Bark of Mutis, but were so named from the

* Handbuch der Botanischen Pharmacognosie, p. 219.

† Ibid., p. 220.

‡ Buchner's 'Repertorium,' p. 250.

peculiar idiosyncrasy of the tree, which, as soon as the bark is cut, yields a peculiar* sap. From the Red Bark tree the juice flows out "milky," according to Pavon, changing afterwards to deep red, and, as observed by Spruce,† the juice is actually colourless, but the instant it is exposed to the air it turns white, and in a few minutes red. This speedy effect of exposure to the air shows the preponderating element to be the cincho-tannic acid. The yellowish gum-resinous milk which flows from the wounded *Calisaya*‡ when exposed to the influence of the sun's rays, undergoes a change of similar nature to vinous-purple. On the other hand, the *C. coccinea* yields at first, like the *C. succirubra*, a crystalline juice, which changes, not to a purple, but to a golden colour, owing, no doubt, to the presence of the colouring matter I have described. Pavon does not speak of the change in the *C. lutea*, but it is probable that it is similar.

Winckler,§ in his analysis of the Pale Jaen Bark, speaks of it as characterized by "a most intense greenish-yellow colour." The occurrence of an abundance of the same colouring-matter is remarkable in the *Cascarilla hexandra*, Weddell,|| an examination of the bark of which, called *China Jaen fusca*, is given by Winckler,¶ and compared with a previous analysis of the Pale Jaen Bark, the product of the present species. It will be seen by reference to this description, that the bark produced only an alkaloid called Paracin, from its resemblance to Aricine; but apparently the truth is, that the chemist was not able to separate the aricine from the strongly implicated yellow resin, and that in fact we have an analogous composition in this kindred plant to that of the low aricine-producing *Cinchona* which I have mentioned above.

It is at all events remarkable that the similarity in the colouring-matters and in the alkaloids of the above barks should have struck the experienced chemist alluded to, and it confirms the theory of the aricine-producing yellow *Cinchona* standing near the verge of the kindred *Ladenbergia*.

Our present species, the *Cinchona lutea*, thus proves to be the source of the Pale Jaen Bark of the Germans. I have a specimen of this from Winckler (given me by Pereira), and can thus speak confidently of its identity with the bark of *C. lutea* in Pavon's collection. Its microscopic examination also coincides well with that of the *amarilla de Chito*, or Yellow Bark of Jaen. This is the bark from which Manzini obtained an alkaloid, which he named *Cinchovatin*, supposing that the bark was that of *Cinchona ovata*, from which, however, as represented in Pavon's collection, it differs entirely. Winckler** showed that this *Cinchovatin* was not any other than the before-known Cusconin or Aricine, discovered by Pelletier in the very nearly allied *C. Pelletierana*. Botanical and chemical researches on these species have thus tended to illustrate and confirm each other.

* See Pavon's Obs. 2, in which possibly the word *lacteus* should read *luteus*.

† Spruce's Visit to the Cinchona Forests of the Quitensian Andes: Journal of the Linnæan Society, vol. iv. No. 16, p. 183.

‡ Weddell's 'Histoire,' p. 33.

§ Buchner's 'Repertorium,' 2te Reihe, Bd. i. pp. 179-192.

|| De Candolle, Prod. t. iv. p. 356.

¶ Buchner's 'Repertorium,' 2te Reihe, Bd. xli. pp. 145-158.

** Ibid., 2te Reihe, Bd. xxxi. p. 249.



W. E. Birch del. et lith.

CINCHONA CONGLOMERATA, Pavon.
 Cascarilla colorada.
 "Red Bark"

W. West imp.

CHINCHONA CONGLOMERATA.

CHINCHONA CONGLOMERATA, foliis oppositis, petiolatis, lanceolato-oblongis, capsulis paniculatis, umbelluliferis conglomeratis.

Arbor 6-7-orgyalis. *Truncus* teres, ramosus, comâ frondosâ ramosâ. *Lignum* compactum, solidum. *Cortex* fusco-griseus, scaber, rimis plurimis transversalibus, appropinquatis. *Rami* oppositi, brachyati, teretes, cortice fusco valde amaro, acidulo non ingrato, intus cinnamomi colore, villosi, *teneri* striati, tetragoni, dilute purpurei. *Folia* opposita, petiolata, horizontalia, nonnulla dependentia, lanceolato-oblonga, obtuse acuta, subundulata, integerrima; subtus villosiora; maxime per nervos et venas; supra nitidiuscula; villis supra deciduis, subtus persistentibus; glandulis rotundatis, subtus concavis, villis per marginem obsitis, supra prominentibus, ad axillas nervorum insertis. *Folia superiora* minora, lanceolata, nutantia, undulata. *Petioles* breves, pollicares, pubescentes, supra canaliculati, obscure purpurei, subtus teretes, basi incrassati. *Stipulae* duæ, oppositæ, cauli appressæ, erectæ, integerrimæ, oblongæ, interfoliaceæ, supra-axillares. *Pedunculi communes* axillares terminalesque, paniculati, villosi. *Pedicelli* villosi; fructificationibus umbelluliferis, conglomeratis; bracteolis duabus, oppositis, subulatis, concavis, pubescentibus, ad basin et in medio solitariis, insertis. *Capsula* ovalis, striata, pubescens, rosaceo colore, striis prominentibus, sulcis duobus oppositis, basi hians. *Semina* oblonga, alâ membranaceâ luteâ, inæqualiter laceratâ. *Receptaculum* lineare.—*Habitat* in agro, vulgo “*la Hacienda de Huarandosa*” nominato, ditone Partido de Chirinos, Jaen de Bracamoros; Provinciâ Quito. *Floret* Junio et Julio. *Vulgo*, *Cascarilla colorada*.—*Obs.* Vires et usus in medicina et commercio magno usu fit. Cortices virtutibus eminentibus præstant in febris tertianis.—*Pavon*, *MS. Nueva Quinol. sub sp.* 41.

I cannot find that this species has been noticed by any botanist since the time of Pavon, from whose herbarium in the Royal Museum at Madrid our drawing was made.

The quills of this sort, as collected by Pavon, and in my possession, are very peculiar, and distinguished by great density of structure, with a rough corrugated surface, marked by abundance of cross cracks and wrinkles, which, however, are much less deep than in the *C. Uritusinga*, to which in other respects it bears some resemblance. It would form a fine description of bark if imported, but I have very rarely seen such in commerce. It appears to have been in use in the time of Pavon, and, from the name which he ascribes to it, had some claim to be considered a *Red Bark*. The transverse section of the quills discloses a rusty-red colour in the substance of the specimen quills, but on the whole they resemble more closely the Loja sorts than those known in commerce as Red Bark.

The specimen quills in my possession from Madrid are ticketed “*Cascarilla colorada de Loja, de la Provincia de Jaen, C. conglomerata*;” the same from the Berlin collection are labelled “*C. conglomerata, Cascarilla colorada de Jaen*.” The latter designation is most according to the habitat given above as at Chirinos, which is near Jaen, but the former leads to the inference that it may also have been found in the neighbourhood of Loja, and that it may be the source of the bark called *Colorada de Loja*, which differs much from the *Colorada del Rey de Loja*, and assimilates with a small specimen, in my possession, of bark collected by M. Joseph Jussieu, with this inscription, in the Museum of the Jardin des Plantes at Paris, “*Quinquina de la Montagne de Cajanuma, près Loja*,

Cascarilla colorada (Kinakina, *cortex ruber*) rapporté de Pérou par Jos. Jussieu, qui la considère comme le plus efficace, et comme déjà très-rare, et presque inconnu de son temps." The specimen, indeed, still possesses a very bitter taste, and gives a purple sublimate with heat, so that it appears to belong to the better sorts of bark.

The *Colorada de Loja* which I have found in commerce contained 1.68 per cent. of the alkaloids Quinidine (of *Pasteur*), Quinine, and Cinchonine. A small portion of Pavon's specimen of the bark of *C. conglomerata*, which I submitted to analysis, gave me an unusually large product of Cinchotannic Acid, and traces of alkaloid in about usual proportion. Microscopical examination discloses an unusual abundance of the so-called resin-cells, and a structure allied to that of the *Micrantha* barks.

Our figure is drawn from a specimen in the herbarium of Pavon at Madrid, with the label, "Casc. colorada, F. P., n. 590, L. 744. An var. numeri 589?" (i.e. *C. villosæ*) *C. conglomerata*.



W. Fitch del. et lith.

CINCHONA PARABOLICA.
Cascarilla crespilla con Hojas rugosas.

W. West imp.

CHINCHONA PARABOLICA.

CHINCHONA PARABOLICA, foliis oppositis, petiolatis, parabolicis, undulatis, hirsutis, pedunculis, paniculatis, coarctatis. *Arbor* 4-5-orgyalis, comâ ramosâ. *Truncus* solitarius, erectus, teres; cortice extus fusco crasso, scabro, maculis albicantibus, rimis plurimis transversalibus, nonnullis horizontalibus, intus ferrugineo: sapore valde amaro, acidulo, in medicina usurpari potest. *Rami* tetragoni, hirsuti, teneri, purpurascens. *Cortex* ramorum valde amarus, acidulus gratus, in febribus tertianis usurpari potest. *Folia* opposita, petiolata, parabolica, integerrima, undulata, coriacea, rugosa, marginibus revolutis scariosa, supra nitida, glabra, subtus hirsuta, nervosa, venosa; *juniora* per nervos venasque purpurea. *Petioles* teretes, sulcati, purpurascens, basi incrassati, hirsuti. *Stipulae* duæ, oppositæ, interfoliaceæ, supra-axillares, sessiles, cauli appressæ, ovales, acuminatæ, glabræ; marginibus revolutis, nervo intermedio prominente deciduis. *Pedunculi communes* axillares terminalesque, paniculati, tetragoni, hirsuti; bracteolis duobus lanceolatis, pubescentibus, acutis, oppositis, sessilibus, deciduis; *partiales* teretes, pubescentes; bracteolis ovatis, pubescentibus, acutis, ad basim solitariis et in medio suffultis, deciduis. *Calyx* pubescens, purpureus, quinquedentatus. *Flores* nonnulli, sessiles. *Corolla* obovata, purpurea, laciniis intus villosa-tomentosis; villis albicantibus. *Capsula* ovalis, bilocularis, bivalvis, valvulis basi hians.—*Habitat* in viâ collis Laterna, in collibus Vilcabamba, Valladolid, locis altis frigidis Sabaneta, Quebrada Onda et Cruz Grande nominatis, Provinciâ Lojâ. *Floret* Junio, Julio, et Augusto. *Vulgo* Cascarilla Crespilla con hojas rugosas.—Pavon, MS., Nueva Quin. sub sp. 29.

M. Guibourt describes* the bark of this species as the *Quinquina payama de Loja*, a name which is still retained in Peru, and implies the worthless character which is ascribed to the sort in that country. I can confirm this identification, not only from inspection of M. Guibourt's specimens and those in the British Museum, but also as having in my possession a specimen of Pavon's from Madrid, with the inscription, "*Cascarilla con hojas rugosas, de Loja, Cinchona parabolica.*" The bark is distinguished by its fibrous character, easily splitting longitudinally into long filaments. It contains very little alkaloid. I have found about seven parts in a thousand of the bark, and this chiefly Quinidine. Although so inferior, it is sometimes imported, and generally in parcels unmixed with other sorts.

Pavon's specimen gives an abundant pink sublimate by heat, indicating thus a superiority over the *C. microphylla*, which only affords a brown-yellow oily distillate. The last observation holds good as regards my aricine-producing specimen of the bark of *C. microphylla*. There is great similarity in the dark-grey external aspect of this bark and that of the *C. microphylla*; but in our present species the easy exfoliation of the periderm, leaving a derm slightly imprinted with cross furrows, is highly characteristic. It is also, I think, in general stouter than the other sort, and presents in some portions of the surface a silvery aspect, from the denudation of the white micaceous epidermis.

Dr. Weddell unites this plant with the *Cinchona macrophylla* of Pavon, under the head "*Cinchona Mutisii*, var. *a*, *microphylla*, var. *β*, *crispa*." He remarks in reference to the present species, that of all the plants of this genus this is one of the most easy to recognize. The hairs which clothe the internal face of the tube of its corolla render it specially remarkable.

Our figure of this plant is drawn from a specimen at Madrid, entitled, "*C. parabolica, Casc. con hojas rugosas*, 562 L. 723, ex Loja."

* Histoire des Drogues, vol. iii. p. 159, 4^{me} éd.



W. Fitch del et lith.

1. CINCHONA MICROPHYLLA
 Cascarilla crespilla con Hojas de Roble.
 2. CINCHONA RUGOSA.
 Cascarilla crespilla de Cuenca.

W. West imp.

CHINCHONA MICROPHYLLA.

CHINCHONA MICROPHYLLA, foliis oppositis, petiolatis, ovatis lanceolatisque, acuminatis, villosis, marginibus retroflexis, paniculatis, terminalibus.

Arbor 2-3-orgyalis, ramosa, comâ frondosâ. *Truncus* erectus, teres, ut plurimum duo, aliquando solitarius. *Cortice* nigricante scabro, sapore amaro, non ingrato, nonnullis maculis albicantibus ferrugineisque, rimis transversalibus plurimis, nonnullis longitudinalibus. *Rami* oppositi, erecti, tetragonales, angulis obtusis, hispidovillosi, uti tota planta, villi densissimi. *Folia* opposita, petiolata, ovata lanceolataque, obtuse acuminata, marginibus retroflexis subundulatis, integerrima, hispido-villosa villis densissimis, supra nitida, villis rarioribus, deciduis, et cum majora sunt glabra apparent, nervosa, venosa. *Petioles* breves, teretes, basi crassiores, villosi. *Stipulae* sessiles, interfoliaceae, oppositae, supra-axillares, oblongo-ovales, integerrimae, obtusae, villosae, deciduae. *Pedunculi* communes paniculati, terminales, tetragonales, pauciflori; bracteolis primoribus oppositis, villosis, concavis, subulatis, superioribus oppositis, ovatis, concavis, apice subulatis. *Pedicelli* teneres, breves, villosi, bracteolâ unicâ in medio et ad basim parvâ, ovatâ, acuminatâ, concavâ, villosâ. *Flores* intus et extus villosi, parvi. *Calyx* villosus, rosaceus. *Corolla* dilute violacea. *Stamina* rosacea. *Pistill.*: *germen* minimum, subobovatum, villosum; *stylus* filiformis, purpureus, staminibus brevibus. *Capsula* oblonga ovato-oblongaque, villosa villis deciduis, purpurea, basi aperiens.—*Habitat* in collibus Angamema et Macas prope Vilcobamba, Lojâ Provinciâ. *Floret* Maio, Junio, et Julio. *Vernacule*, *Cascarilla Crespilla con hojas de Roble*.—*Obs.* 1. Flores hujus species benzoinum redolent; non est in usu. *Obs.* 2. Cortices in fracturâ fibrillosi, sapore amaro præstant.

This plant is united by Dr. Weddell with the *C. parabolica*, Pavon, as forming two varieties of the same species. These certainly may be looked upon as somewhat similar plants, especially when viewed in conjunction with the *C. rugosa*, which may in some respects be regarded as an intermediate form. But I confess that to my mind the characteristics of the present plant appear to be sufficient to constitute it a distinct species. Its peculiar fragrance tends rather to an alliance with the kindred families of sweet-scented *Ladenbergiæ*, whilst the villous capsules, the hairy leaves, and the chemical constituents of its bark, place it low in the scale of the family of the *Cinchonæ*. The bark is represented in Pavon's collection by a specimen in my possession, called *Cascarilla Crespilla con hojas de Roble, Loja, Cinchona microphylla*. A similar sort comes occasionally from Peru. I noticed one seron in a sale which has just occurred. It is rather in favour with the dealers, I know not from what cause, as it is extremely poor in alkaloids. I have not been able to discover any of these but Aricine, and of that only 0.23 per cent. The sublimate which it gives by heat is brown-yellow rather than red. It is well characterized by Pavon as distinguished by its "fibrillous fracture."

Our figure is drawn from a specimen of this plant in the herbarium at Madrid, labelled "*C. microphylla, Casc. con hojas de Roble de Loja, F. P. 724, No. 564.*"

The microscopical examination of this bark and that of the kindred *C. parabolica* is interesting, chiefly as showing the arrangement of the ligneous fibres on which the peculiarly fibrous character depends.

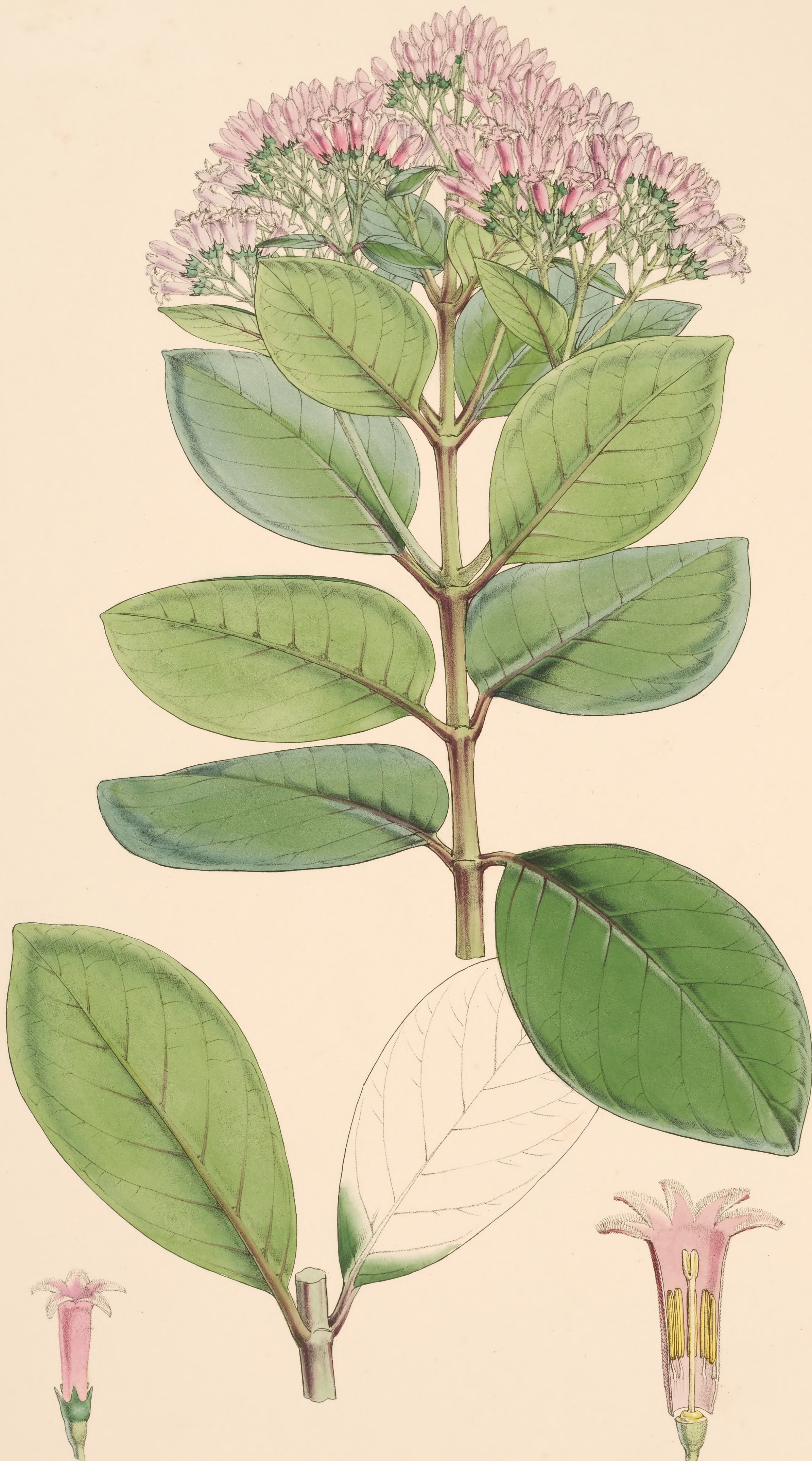
CHINCHONA RUGOSA.

CHINCHONA RUGOSA, foliis oppositis, petiolatis, ovalibus subrotundisque, rugosis, nervosis, reticulatis, hispidis, pedunculis paniculatis.

Arbor 3-4-orgyalis, comâ parvâ. *Truncus* erectus, teres; cortice nigrescente, parum amaro. *Rami* tetragoni, hispidi. *Folia* opposita, breviter petiolata, ovalia subrotundaque, integerrima, rugosa, venosa, venis reticulatis subtus hispidis, nervo centrali purpureo, supra glabra, scariosa, nitidissima, coriacea, cum brevi acumine, marginibus revolutis. *Petioles* subteretes, hispidi, purpurei, breves. *Stipulae* duæ, oppositæ, sessiles, interfoliaceæ, supra-axillares, rotundatæ, nitidæ, glabræ, parvæ, marginibus revolutis, coriaceæ, citissime decedentes. *Pedunculi communes* axillares terminalesque, paniculati, tetragoni, hispidi; *partiales* hispidi, tetragoni; bracteolis duabus, oppositis, ovatis, sessilibus, subulatis ad basim. *Pedicelli* breves, bracteolis minimis ovatis, ad basim et in medio solitariis. *Flores* nonnulli sessiles. *Corolla* rubicundo-purpurea, extus hispida; laciniis intus villosis, tomentosis, revolutis. *Antheræ* lineares. *Capsula* oblonga, bilocularis, bivalvis, basi hians.—*Habitat* in montibus Provinciæ Cuenca Regni Quitensis. *Floret* Junio, Julio, et Augusto. *Vulgo*, *Cascarilla crespilla*.—*Pavon*, MS. *Nueva Quin. sub sp.* 25.

Our figure of this plant is taken from a specimen in the herbarium at Madrid, entitled, "*Cinchona rugosa*, Pavon, icon. 751, no. 680, *Cascarilla Crespilla de Cuenca*, 1809."

I have nothing certain to remark of the bark of this species, as it does not appear in the collection of Pavon; and as the species has not been noticed by any other botanist, I cannot trace the product in commerce.



W. Fitch del et lith.

CINCHONA HETEROPHYLLA.
Cascarilla negra vel negrilla.
"Negrilla Bark"

W. West imp.

CHINCHONA HETEROPHYLLA.

CHINCHONA HETEROPHYLLA, foliis oppositis, petiolatis, obovatis cordato-ovatisque, oblongis ovalibusque, pedunculis racemosis, capsulis ovalibus.

Arbor 10–15-orgyalis. *Truncus* erectus, teres, ramosus, comâ frondosâ. *Cortex* asper rimis longitudinalibus transversalibusque, nigerrimus, maculis fuscis albicantibus, sapore amaro. *Rami* tetragoni, cortice purpureo, oppositi. *Folia* opposita, breviter petiolata, obovata, ovata cordato-ovataque, oblonga ovaliaque, integerrima, obtusa, breviter acuminataque, venosa, nervosa, marginibus revolutis, coriacea, utrinque glabra, supra nitida, nervis nervoque centrali purpureis, basi parum decurrentia, superiora adultiora opposita, petiolata, cordato-ovata ovataque, glandulis nonnullis subtus rotundo-concavis, marginibus villosis, villis albicantibus supra prominentibus, villis albicantibus, ad nervorum axillas insertis. *Petioles* teretes, striati, purpurei, subtus compressi. *Stipulae* duæ, oppositæ, supra-axillares, interfoliaceæ, obovatæ, integerrimæ, striatæ, nervo centrali subtus prominente, sessiles, virides. *Pedunculi communes* axillares terminalesque, racemosi, tetragono-obtusi, oppositi. *Partiales* oppositi, bracteolis oppositis, subulatis, sessilibus, ad basim inserti. *Racemi* breves, folioli tetragono-obtusi, striati. *Pedicelli* breves; bracteolis solitariis, subulatis, minimis, ad basim et in medio insertis. *Flores* nonnulli pedicellati, alii sessiles. *Calyx* quinquedentatus, denticulis subulatis, viridis. *Corolla* purpurea, laciniarum marginibus villosis, villis albicantibus extus pubescens. *Antheræ* lineares, luteæ, faucis altitudine. *Capsula* ovalis, angulis duobus oppositis, calyce coronata, nonnullis striis, a basi ad apicem hians. *Receptaculum* centrale, oblongum. *Semina* oblonga, alâ membranaceâ, inæqualiter dentatâ, subluteâ.—*Habitat* in collibus, confinitimis ad vicum de los Azogues nominatum, in Provinciâ de Cuenca appellatâ, in Quito. *Floret* toto fere anno. *Vernacule* ab incolis *Cascarilla negra* o *negrilla* appellata.*—*Pavon, Quin. sub spec. 37.*

This tree appears, by the specimens of Pavon's collecting, to be the origin of the very pretty, but practically unserviceable bark called *Quina negra* or *negrilla*, which is not unfrequently mixed with the quill of Calisaya. It appears also to be the sort of Loja bark figured by Goebel in his Taf. V., and by him erroneously attributed to the *Cinchona scrobiculata* (the bark of which has a character entirely its own, and well represented by Delondre and Bouchardat in their Pl. III., under the head "Quinquina rouge de Cuzco"). It is remarkable for its blackish-grey colour, contrasting prettily with the white foliaceous lichens with which it is often overspread. The internal colour is dark-brown, and the specific gravity remarkably great. I have found it to contain a large proportion of cincho-tannic and kinovic acids, also Quinidine (of Pasteur) and Cinchonine, together 1.48 per cent.

This species has been confounded with the *Cinchona discolor*, Klotzsch (*Chinchona obovata*, Pavon), from which, however, it is entirely distinct.

Examination by the microscope shows a peculiar character, rendered more striking by the abundance of colouring matter in the external layer of the bark.

* *Observatio*.—"La *Cascarilla colorada*, así llamada por los naturales cascarilleros, es una variedad de esta especie que solo varia en los colores de hojas, calyces, corolas y figuras de las capsulas. Lo mismo acrece a las otras dos variedades que llaman *Cascarilla negra* o *negrilla* 1ª y 2ª variedad que se observa un poco de vello en los nervios y venas; todas tres variedades son de poco momento, y se habitan juntas en los mismos cerros montuosos cerca del Pueblo de los Azogues así llamada en la Provincia de Cuenca, en Quito, y florecen todas al mismo tiempo casi todo el año."—*Pavon, l. c.*



W. Fitch del. et lith.

CINCHONA URITUSINGA. Pavon.

Cascarilla fina.

Original Loja Bark.

W. West imp.

CHINCHONA URITUSINGA.

CHINCHONA URITUSINGA, foliis oppositis, petiolatis, lanceolatis; pedunculis axillaribus terminalibusque, paniculato-corymbosis, trifidis.

Arbor 20-ulnaris et ultra. *Lignum* compactum, luteo colore. *Truncus* solitarius, erectus, teres, crassus, fuscus, nonnullis maculis nigris obsitus; *comâ* frondosâ, valde ramosâ. *Cortex* scaber, fuscus, maculis nigris fuscis et albicantibus, rimis transversalibus. *Color* intus luteus, amarissimus, acidulus, non ingratus. *Rami* erecto-patentes, teretes; superiores brachiati, complanati, leviter pubescentes, dilute fusci: *ramuli* utrinque sulcati. *Folia* opposita, petiolata, lanceolata, integerrima, acuta, supra glaberrima, nervosa, venosa, subtus per nervos et venas villosiuscula; nervis alternis, rarius oppositis; marginibus revolutis: *tenerima* subtus hirsuta; *glandulis* minimis, rotundatis, subtus concavis, circum villis albicantibus ad nervorum ortum insertis, supra prominentibus. *Petioles* teretes, supra canaliculati, glabri, subtus hirsuti, basi incrassati. *Stipulae* duæ, oppositæ, interfoliaceæ, supra-axillares, ovatæ, acutæ, erectæ, integerrimæ, cauli appressæ, pubescentes, deciduæ. *Pedunculi communes* axillares terminalesque, trifidi, obtusi, tetragoni, paniculato-subcorymbosi, hirsuti, solitarii, erecti, complanati, foliis breviores; *partiales* hirsuti, tri-septemflori trifidique; bracteolis duabus, oppositis, minimis, ovatis, acutis, concavis, rubris, ad basim insertis, persistentibus. *Pedicelli* teretes, breves, pubescentes; bracteolis solitariis, minimis, ovatis, acutis, persistentibus, ad basim et in medio insertis. *Flores* nonnulli, sessiles. *Calyx* campanulatus, ruber, glaber, in fructu ampliatus, denticulis retroflexis persistens. *Corolla* albo-rosacea, extus pubescens. *Tubus* intus glaber. *Limbus* quinque-partitus, patens; laciniis villosito-tomentosis; villis albicantibus, densis, longiusculis. *Capsula* oblonga, angusta, striata, striis longitudinalibus prominentibus utrinque sulcata, lævis, calyce crescente ampliato coronata, denticulis retroflexis, bilocularis, bivalvis, basi dehiscens. *Semina* minima, fulva, alâ obovatâ leviter lacerâ albo-pallescente circumdata. *Receptaculum* lineare.—*Habitat* in Peruviae Andibus montibus, Pillao et Chicoplaya, et prope Guancabamba et Ayavaca, ubi Johannes Tafalla invenit, et prope Loja in collibus Cajamuna, Uritusinga, Boqueron, Villonaco, Huancabamba, et Ayavaca. *Floret* Maio, Junio, Julio, et Augusto. *Vulgo*, *Cascarilla fina*.—*Obs.* Cortices hujus speciei ad febres intermittentes magno usu et in commercio fit.

Quina-Quina, Condamine, Act. Paris, 1738. Lambert, A Description of the Genus Cinchona, p. 14. t. 1. Pavon, MS. Nueva Quin. sub sp. 34.

Cinchona academica, Guibourt, Drogues Simples, tome iii. p. 98.

The *Cinchona Uritusinga* grows to the height of a lofty forest tree, and appears to have adorned the mountains in the neighbourhood of Loja at an early period, and to have furnished a considerable proportion of the supplies of Loja bark, until it became almost exterminated by the wasteful method of cutting adopted by the cascarilleros, so that twenty-five thousand bark-trees were destroyed in one year. Even in the time of La Condamine, in 1736, it had become rare in the vicinity in which it was discovered, the very large trees from which the first barks were procured having all perished, as I have before noticed under the head *Cinchona Chahuarguera*, in which place I have described the remaining species of Loja bark, which are still imported in quantity, and have almost entirely superseded this sort.

It is at present rare to see any Loja bark which is the product of the trees of any size, such as is found, for instance, in the section of a branch of the *C. Uritusinga* in Pavon's collection in the British Museum, and which represents admirably the peculiarities of this sort. There are also

some fine quills in the Madrid collection now in my possession. I have moreover received, through the hands of Don T. F. Riofrio, a remarkably fine specimen of the bark of *La Condaminea*,* which M. Mastenbroek, of Amsterdam, informed me was "identical with the true Loja bark of Linnæus, proceeding from the collection of M. Seba, his friend." This was accompanied by specimens of flowering and fruit-bearing branches of the same tree, and that very evidently the same with the *C. Uritusinga* of Pavon, as drawn by Mr. Fitch at Madrid (marked 1 in our Plate). The reader can judge of this for himself, as he will find these represented in the branch with capsules and the coloured leaf showing the tints acquired in decay (and marked 2 in our Plate), of which abundant specimens were furnished. From the seeds enclosed in the capsules I have been able to raise several plants, of which one has now attained the height of three feet; for though at first the development is remarkably slow, this is not the case in the second year of their growth, at the end of which period these young plants now are found. The leaves are as large as the upper unshaded branch from Madrid, and of the same shape, the general contour of the whole resembling that branch. The small plant (3.) on the opposite side resembles the young plant in its early development; but, as being slightly magnified, it appears rather more hirsute than is even then natural. In the early stages of the plant the scrobicules are not apparent, but they are very distinct in a state of vigorous growth. The bracts should appear on the uppermost node of the unshaded branch; after this period of growth they fade and fall immediately.

The leaves assume a red colour before they fall; one by one, as is represented in the Plate, acquiring the beautiful tints which I have before mentioned, as generally indicating much cincho-tannic acid in the plant itself. The blood-red colour is sometimes very striking; and it may be worthy of remark, that the *aphides* which sometimes infest the plant, acquire a red colour in parts of their bodies whilst digesting the juice of the leaves on which they feed. The bark shows also an abundance of colouring matter, being quite cinnamon-coloured on the inside and very dark-brown on the upper surface, with abundance of the cross-rings with everted edges which characterize this sort. The colour of the petioles and veins of the leaves varies, as may be supposed, with the amount of light and warmth. In summer these are of a rich maroon-red; in winter the leaf is of a bright green throughout the smooth upper surface, and paler on the equally smooth under side. The whole plant appears to be very sensitive to the light, and grows best, with me, as is also noticed by Dr. Junghuhn of the Calisaya in Java,† when the light is only admitted to the plant from above. It has at all events a great tendency to grow towards the light, and yet does not seem to thrive so well if this is too abundantly bestowed. Dr. De Vrij writes me‡ that he finds the position of the tree has a great influence on the quality of the alkaloids. In a Calisaya-tree, for instance, which was placed in the bare sun, without the least shade, he found a tolerably large quantity of cinchonine, whilst in examining the bark of trees grown in the shade of the forest, he found only very minute quantities, which could scarcely be isolated.

I have mentioned, under the head *C. Chahuarguera*, the opinion that the bark differs in quality

* Written in pencil, apparently "*Fina vasto tunja, ó la Condaminea*;" also in another place, "*Sambo pongo*." These country names probably refer to the black and rough exterior.

† Bonplandia, viii. Jahrgang, p. 230, etc.

‡ Date, September 3rd, 1860.

on the mountains of Uritusinga according as it is exposed to the morning or the evening sun.* It may be not out of place to mention also here a curious practice by which the inhabitants of Loja flatter themselves that they secure economical bark-cutting. They cut off (Don Riofrio told me) the whole of the bark of the trunk of a small tree, leaving only one broad strip, so as not to destroy the tree, which gradually replaces its loss; and the second time of cutting, the bark is called *Cascarillas reseccadas*, and esteemed as of superior quality. This practice appears to be as old as the time of Ruiz, as I find it mentioned in a MS. of his in the British Museum.†

I think there can remain no doubt that the present species is the one described and figured by M. La Condamine; and, as I have mentioned in my first part, it is consequently the *C. academica* of Guibourt, which is very well figured in his 'Histoire des Drogues Simples,' and contrasted with the shaded branch in tom. i. pl. x. of the 'Plantes Equinoctiales,' which latter the reader will find described under the head *Cinchona crispa*.

I mentioned my belief (in the 'Examination of Pavon's Collection,' 1852-3,) that the old original "Crown Bark," the fine Loja of Uritusinga, was one which well merited its character, on account of the quantity of alkaloids it contained, which (taking the whole together) equals the Calisaya bark of Bolivia. I then also expressed the opinion, to which I still adhere, that this is one of the species which it would be important to introduce into other regions of the world.

I have also described, as apparently belonging to this species, a parcel of fifteen chests which came in 1850 *viâ* Lima. This yielded nearly two per cent. of Quinine, and (with the other alkaloids, Cinchonidine and Cinchonine) gave a total of 3.80 per cent. This importation probably resulted from an accidental discovery of some untouched portion of the old forests, and no such parcel has been introduced since.

The College of Physicians, London, also possesses some very fine quills of this old Loja bark. From a small portion which was given me by the College, I obtained 3.662 per cent. of alkaloid. Don T. F. Riofrio, though a native of Loja, had never seen specimens of Loja bark equal to these; that which was familiar to him as the Loja bark of the present being the produce of *Cinchona crispa*, described under that head.

The microscopical examination of the bark of the *Cinchona Uritusinga*, as sent me by Don Riofrio, is interesting, and appears to indicate a superior quality. The cells are generally large, and by no means thick-walled, but in the intervals between the very abundant medullary rays become broken up into very small round or polygonal cells. The cortical fibres are not numerous, but are seen scattered throughout the substance of the bark, and seldom approaching to each other. Starch is abundant in some of the cells. Resin-cells are present but sparingly, and small definite *lacunæ* are seen at almost

* The reader will find some curious and interesting particulars in connection with this influence of eastern or western mountain-slopes in Java in 'Bonplandia,' March, 1848, p. 88.

† In the following terms:—"Unicamente se práctica en Loja la operacion de sacar de los troncos y ramas de los Quinos la mitad de la corteza, por un lado á lo largo, dejando la otra mitad para recogerla al siguiente año ó quando ya se halle esta estendida por ambos lados, hasta casi unirse sus dos bondes ó margenes. Esta operacion, en lugar de ser benefica, es muy prejudicial, por que con ella se maltratan los árboles y retardan infinito su vegetacion, si acaso no mueren, como sucede con muchos despues del *resague*. Así llaman á este segundo corte, y á las cortezas denóminan *Cascarilla* ó *Quina de Resague*. De ningun modo deberia permitir el Gobierno se tragar á los Quinos dicha operacion, por que con ella se han destruido muchos árboles de Cascarillos de los montes de Uritusinga, Anta Caxamuna y otros de la Provincia de Loja."

regular intervals. The cells of the epidermis are large and generally rounded, retaining in measure the dark colour they originally possessed.

Flowering and fruit-bearing specimens of the *C. Uritusinga* exist in the Museum at Kew as "*Cinchona Condaminea*, collected by Mr. Jameson on the Cerro de Uritusinga, near Loja." I have also, as given me by the Pharmaceutical Society, a portion of "the bark of *C. Condaminea* from the Uritusinga mountains near Loja," given to the Society by Dr. Lindley. It is not yet therefore quite extinct, which fact is also apparent in the occasional intermixture of small portions of the bark in parcels coming from Loja.

In conclusion, I must advert to a variety (apparently) of this species which is found in Pavon's collection, and said to have been "discovered by Tafalla near the famous river Ucayali, at the right, in the woods of Chicoplaya, the *Cascarilla parecida á la Quina anaranjada de Mutis*." This appears, as noticed by Schleiden in his 'Pharmacognosie,' to be a very different bark to that growing near Loja.

Dr. Martius published* a description of the Loja barks, taken from the manuscript of J. de Caldas, as observed by him in the years 1805-1809. The following particulars appear to refer to our species:—

"The esteemed Cinchona of Loxa is a tree of from ten to sixteen yards in height. It is seldom found single; commonly two, three, or more stems proceed from the same root. In the first instance the stem is quite perpendicular, in the latter case a little bowed towards the horizon.

"The bark is very variable in its outer surface; according to its age, temperature, and situation, it varies from clear brown to black. When the stem and the branches are completely exposed to the sun and the wind, the bark becomes black; but when the tree is thickly surrounded by others, it assumes a brownish colour, which changes even to a clear yellowish-grey: a great number of lichens grow on the whole of the outer surface. On the epidermis, whatever may be its colour, are found at intervals impressions or wrinkles, forming *rings*, which mark the places where the leaf-stalks were seated. Although very superficial, these rings are easily discerned. Immediately under every ring are seen two almost circular scars, which are occasioned by the separation of the leaf-stalks at the fall of the leaf. Between the rings are to be noticed many other wrinkles and clefts across the bark, for the most part parallel to the others, but not running quite round the stem, and always of variable length, depth, and distance from one another.

"The crown of the tree is ovate, and rich in leaves. The leaves are opposite, between oblong and lancet-shaped, entire, . . . shining on both sides, above somewhat green, paler on the under side, the nerves and veins of a rosy colour. The leaves at the end of the twigs are four to eight inches long, and two to four wide (the largest measure scarcely exceeds that of the plant as growing in my possession). When they are young and tender they have on the under side a short and tender pubescence, and when they have passed maturity they become of a bright scarlet colour (*color coccineo muy subido*).

"The manner in which this Cinchona flowers is differently represented by different authors, and therefore requires setting forth more clearly. The peduncle ends the bough. It is first divided into three, the middle branch being the strongest, growing upright, forms the axis of the whole inflorescence. The side branches are smaller, growing transversely, and again parted into three, even to the smallest, which immediately bear the flowers. The axis is divided in the same manner as the rest. The pedicels stand always in a cross upon their common peduncle. According to this relation, I believe that the name *corymbus* does not apply, and that the description of Willdenow gives a true idea of the inflorescence: *panicula terminalis, patens, trichotoma*."

This trichotomous structure is noticed also by Bonpland in the description in the 'Plantes Équinoctiales;' and it will be seen by our Plate that it markedly characterizes the present species. On this account Pavon seems to have meditated calling it *Chinchona trifida*, but erased this in favour of the present name.

* Note (*) in 'Flora,' 7 July, 1846.



W. Pitts del et lith.

CINCHONA NITIDA.

Quina cana legitima.

"Grey Bark."

W. Westing.

CHINCHONA NITIDA.

CHINCHONA NITIDA, foliis oppositis, petiolatis, obovatis, ovali-oblongis ovato-oblongisque, nitidis, paniculâ terminali.—

Sp. Pl. Flor. Per. et Chil. vol. ii. p. 50. *Cascarillo officinal*, Ruiz, Quinologia, Art. 2, p. 56.

Arbor procera, a decem usque ad quadraginta ulnas, glabra. *Truncus* solitarius, erectus, teres, aliquando tres aut quinque repullantes. *Cortex* extus scaber, fusco-nigricans, sæpe ex fusco et cinereo colore variegatus; intus obscure fulvus, amarissimus, acidulus non ingratus, in commercio et in febribus tertianis magno usu fit. *Rami* seniores teretes, scabri, fusco atri-cinereo colore variegati, *teneri* leviter tetragoni, fusci. *Folia* opposita, petiolata, obovata, ovali-oblonga ovato-oblongaque, integerrima, nitidissima, decurrentia, marginibus ad basim revolutis, subtus venosa, venis purpurascens, glandulis rotundis oblongisque, supra prominentibus, subtus concavis, ad sinus nervorum ortum insertis, villis longis albicantibus vestitis. *Petioles* subtus semiteretes, supra planiusculi, purpurei. *Stipulae* interfoliaceae, oppositae, supra-axillares, basi coadunatae, oblongae, sessiles, obtusae, intus rubescentes, marginibus reflexis. *Panicula* terminalis, composita, subracemosa, rubescens. *Pedunculi* multiflori, tetragoni. *Flores* breviter pedicellati. *Pedicelli* bracteolis ovatis acumine subulato concavis ad basim stipati, persistentes. *Calyx* parvus, purpureus. *Corolla* alba, extus dilute rubicunda, vix semipollicaris, laciniis intus villosis, villis albicantibus. *Capsula* oblonga, decem-striata, rubescens, bivalvis, valvulis basi hiantibus. *Semina* ovalia, fulva, alis membranaceis oblongis inaequaliter denticulato cincta.—*Habitat* in Andium montibus altis, nemorosis, frigidis, ad Pampamarca, Chacahuassi, Casapi, Casapillo, Cayumba, Sapan, Cuchero, aliisque tractibus, et in montibus Provinciarum Huamalies, Tarma et Jauja. *Floret* Maio, Junio, et Julio. *Vulgo* *Cascarilla fina* aut *Quina fina*. *Vis* antifebrilis, tonica, adstringens, roborans, stomachica, antiseptica, suppurationem promovens.—*Obs.* 1. In Provinciis Huanuco, Tarma, Jauja et Huamalies, hæc species pro vero et genuino cortice Peruviano et majori pretio, quam reliquæ species nostræ venundatur. *Obs.* 2. Hæc species magnam affinitatem cum *Ch. officinali* habet: an eadem species?—*Pavon, MS. Nueva Quin. sub spec.* 33.

This lofty tree, which abounds in the higher regions of the forests of Huanuco, produces, according to Ruiz and Pavon, the finest “Grey Bark;” to which sort the designation *Quina cana* was not however restricted, but extended to others which, in common with this, are distinguished by the silvery lustre of the bark.*

This observation applies with still greater force to the present state of things, when, in consequence of the changes incident to the current of commercial affairs, the supply of “Grey Barks” has almost entirely ceased from the Huanuco district.

The cause of this change is to be found in the following circumstances. Don Ildefonso Villamil,† a resident in the district, undertook to collect bark for the supply of the European markets, but did

* “De la *Quina* llamada *Peruviana* ó *Cascarilla fina* de las montañas de Huánuco.”—Ruiz, Quin. Art. 2, p. 256.

“Algunos llaman *Quina cana* á esta especie; pero el nombre de *cana* le estienden á otras varias especies que, como esta, tienen canoso el envés.”—MS. Brit. Museum, Ruiz, Compendio de las Quinas.

† Samples sent by the above collector came into my possession, together with the following information, under date of August, 1848. The Nos. 1, 2, and 3 agree exactly with specimens recently brought by Mr. Pritchett of the barks of *C. nitida* and *C. micrantha*, deprived of the periderm. The result shows how inexact was the determination of the percentage of Quinine.

“Mons. Poinson, of Paris, has shown that the Nos. 1, 2, 3 are most abundant in Quinine, having produced, No. 1, say 2¼% of Quinine, very little less than that of Bolivia, which seldom gives more than 2½%. The three classes, say Nos. 1, 2, and 3 mixed, which is similar to what *has been accustomed to be sent for Bolivia since its exportation*, and which I have likewise shipped, is that which *we call Calisaya*. Notwithstanding those three classes of Peru *being the same tree*, do not

not succeed in the enterprise, owing, as I believe, to his not having ascertained sufficiently the qualities required by the consumers, and being misled as to the value of those he exported. This ill success has discouraged others, so that the result at the present time is as I have stated.

It follows that the "Grey Barks" now found in commerce are produced in other parts of Peru, and are by no means the bark of the present species. The *Cascarilla Provinciana*, the bark of *C. micrantha*, is the most common; and next to this the *Cascarilla Pata de Gallinazo*, which differs from the first; there are also to be noticed a variety of inferior sorts, amongst which the bark of *C. suberosa*, Pavon, is the most abundant.

In the uncertainty which appeared to me to rest upon some of the descriptions and specimens of the *C. nitida*, I thought it best to defer the description of this species until I could learn the result of the researches of Mr. Pritchett in the forests of Huanuco. In preparation for the task which this gentleman undertook in connection with the supply of seeds of *Cinchona* to the Indian Government, I gave all the information in my power, together with specimens of the bark and the names of places where these were found in the time of Pavon. I am glad to find that these details have been useful. Mr. Pritchett has now (December, 1860) returned, having left the woods of Huanuco in September, and brought back well-preserved botanical specimens, together with sections of the branches of the same trees from which those specimens were taken. He has also obtained an ample supply of seeds of the *C. nitida*, *C. micrantha*, and of the *Cinchona* of the *Cascarilla Pata de Gallinazo*, all which are now germinating abundantly at Kew, as also in my possession.

It appears that these three sorts are those alone esteemed at present in the country. The product of the *C. nitida* is called *Cascarilla lustrosa*, a name either derived from, or perhaps having given rise to, the distinctive Latin term adopted by Pavon. The bark of the *C. micrantha* is called (as I have mentioned under that head) *Cascarilla Provinciana*. The third sort, *Cascarilla Pata de Gallinazo*, will be described as a separate species, since it differs even more widely than I was disposed to think* from the *Cinchona micrantha*, and forms a kind of intermediate link to connect this last with the *C. nitida*.

All three sorts would pass with acceptance in commerce as very fine "Grey Bark," unless, perhaps, the now almost unknown *facies* of the *C. nitida* might cause it to be rejected by some. They are alike clothed with the silvery thallus of adherent lichens, and present, especially when wetted with water, a really beautiful appearance, according to Pritchett, almost opalescent at times, when seen in their native woods.

contain the same quantity of Quinine, which arises probably from difference in soil, more or less damp, or of climate. It would be impossible for me to furnish either of the three classes separately in any quantity, for the number of persons employed to cut the Bosques, and which are situated at considerable distances from each other."

The numbers 4 and 5 comprehend the barks apparently of *C. micrantha*, *C. purpurea*, *C. ovata*, etc., and were sent "with the object of showing the classes that were used forty years ago, in time of the Spanish dominion in America, those of *Cocheros* and *Chincon*, and which were those that enjoyed most reputation for their quality, of which large quantities were sent during the six or eight years the cutting lasted, till the War of Independence.

The next bark (No. 6) corresponds very closely with the *Cascarilla Hoja de Oliva* brought by Mr. Pritchett.

"The No. 6 is likewise sent, should it suit. It may be had in greater abundance, and is situated at the inner edges of the Bosques, and could be sold at \$25 per quintal here."

No. 7 is a reddish bark, corresponding to some specimens of *China rubiginosa*.

* See under the head *C. micrantha*, p. 3.

Mr. Pritchett also states, that the *C. nitida* is abundant in the forests of Cocheros (the misspelt *Cuchero* of Pavon, Poeppig, etc.), where, in the autumn of last year, he obtained the specimens mentioned above. It was in the same locality that the species was first observed by Ruiz and Pavon.*

The specimens of the *C. nitida* brought by Mr. Pritchett consist of one exceedingly heavy portion of a branch, about four inches in diameter and fifteen inches in length, and of three sections of smaller branches. The density and high specific gravity are remarkable, and still more so the uneven and rugged aspect of the periderm, not only marked with cross-cracks, but also distinguished by numberless little prominences and knots of corky excrescence, akin to those on some of the Loja barks, and not seen on the other two sorts of bark from Huanuco. All this is covered, however, with the same white silvery coat in its native woods, but this easily rubs off in the dry state.

There is thus sufficient general agreement in the appearance of this bark with that of the *C. micrantha* and the *Cascarilla Pata de Gallinazo*, to allow it to be classed with these as "fine Grey Bark." At the same time the "lustrous" appearance can only be seen when the bark is in a wet state, when all the various adherent lichens put on their full perfection and beauty. When perfectly dry it assumes a remarkably rugose aspect, in most respects similar to that of the *C. Uritusinga*, which it very much resembles, except that the latter does not appear to possess the bright clothing of which the *C. nitida* can boast. The epidermis is on the whole adherent, but where it separates, it peels off in flakes when the bark is bruised or in any manner injured, and then discloses a derm of a rusty-red colour and thick fleshy aspect, about one-tenth the diameter of the branch.

The place of growth of the *C. nitida* is, according to Pritchett, at a greater elevation than the *Cascarilla Provinciana* and the *Cascarilla Pata de Gallinazo*, but they all bear the marks of exposure to the "free air, cold, water, and sunshine," in which they delight.† The effect of this variable, and, on the whole, moist climate, is to clothe the superficies with the thallus of many adherent *Graphideæ*, *Lecideæ*, etc., giving the hoary aspect from which its name, *Quina cana*, or Grey Bark, was originally derived.‡ Further, the exposure to alternate showers and sunshine produces fissures, both cross and longitudinal, which, however, scarcely reach down to the derm and feebly impress its surface, contrasting in this respect with the Calisaya. The fissures are less deep than in my specimen of the *C. Uritusinga*, and have less everted edges.

In addition, Mr. Pritchett brought me a large packet of the bark denuded of the epiderm, presenting in this state the appearance of what was at one time sold as Peruvian Calisaya.

This I have subjected to chemical examination, and find the precipitated alkaloids to weigh, as hydrates, 2.22 per cent. of the weight of the bark. From this I had afterwards to make a slight deduction, chiefly for resin in combination with the alkaloids, and find that it consists of nearly 2 per cent. of Cinchonine, and the remainder soluble in ether and intimately combined with resinous matter,

* "Hanc speciem, mense Julio anni 1780, in Cuchero descripsimus."—Flor. Per. tom. ii. p. 51.

† Quinologia, under *C. officinalis*.

‡ The list of these is very fully given by Fée, according to Pereira, as follows:—*Opegrapha Ruiziana*; *O. Condaminea*; *O. rugulosa*; *O. tumidula*; *Graphis Acharii*; *G. serpentina*; *Arthonia confluens*; *A. divergens*; *A. obtrita*; *Trypethelium variolosum*; *Pyrenula marcidula*; *P. mollis*; *Verrucaria nitens*; *V. theioplaca*; *Ascidium Cinchonarum*; *Lecidea tuberculosa*.

so as to present a difficulty in obtaining the alkaloid in a state of purity. This last crystallizes from ether, and forms a resinous-looking hyriodate, like the Cinchonidine of Pasteur, from which in other respects it differs. It belongs, apparently, to the Cinchonine series.

I could not find, in any of these barks brought me by Mr. Pritchett, a trace of Quinine, nor of Quinidine, the chlorine and ammonia test failing to give the green colour (dalleiochin) which characterizes those alkaloids. The medicinal effect of this sort of bark upon the system must therefore resolve itself very much into that of Cinchonine; and as this is pronounced by Briquet, in his excellent 'Traité Thérapeutique du Quinquina' (p. 468), to be much less energetic than that of Quinine, we need the less regret the disappearance of the *Cascarilla lustrosa* from commerce.

The microscope discloses a great contrast between the bark of this species, whether as brought by Pavon or by Pritchett, and that of the *Cinchona Uritusinga*. The abundance of its resin-cells is particularly to be noticed in this comparison.



W. Fitch del. et lith.

CINCHONA PAHUDIANA, Howard.

Cascarilla crespilla chica.

1. From Uchubamba, Peru.

2. From Java.

W. West imp.

CHINCHONA PAHUDIANA, *Howard.*

CHINCHONA PAHUDIANA, foliis subcoriaceis, subtus pubescenti-tomentosis, plerumque ovato-ellipticis, obtusis, sed in eadem stirpe polymorphis, escrobiculatis, corollæ tubo a basi ad apicem distincte pentagono, angulis medio longitudinaliter fissis.

“*Arbor* 15–25 pedes alta, gracilis, parce frondosa. *Truncus* plerumque erectus vel subarcuatus, 2–2½ uncias crassus; *cortex* peridermide læviuscula cinerascens. *Rami* distantes, divaricati, nudi, tortuosi, inferiores deflexi, cernui, cum ramulis, fragiles (minime flexibiles, nec elastici), *ramuli* subnudi, ad apicem folia crebriora gerentes, *juniores* foliiferi, crassi, rigidi, tetragoni, pubescenti-tomentosi, tomento virescenti-pallido. *Ramuli fructiferi* sæpissime deflexi, nutantes. *Folia* subcoriacea, *juniora* utrinque tomentosa, virescenti-pallida, dein supra (præsertim ad nervos) pubescentia, læte viridia, nitida, *subtus* costa nervisque valde prominentibus, escrobiculatis, albican- tibus, subinde rubescentibus, molliter pubescenti-tomentosa, pallidiora (pallide virescentia), submarginata (sed non revoluta), forma plerumque ovato-elliptica, obtusa, basi attenuata et in petiolum brevem decurrentia; *adultæ* 5–6 uncias longa et 2½–3½ uncias lata; sed in eadem stirpe polymorpha: nunc, præsertim inferiora et e trunco ipso orta, lanceolata, utrinque attenuata, acuminata; nunc ovata, vel ovato-oblonga, vel subelliptica; nunc, præsertim adultiora, ovato-rotundata, obtusissima basique obtusa, nec nisi brevissime in petiolum decur- rentia, 8 uncias longa et 5 uncias lata, rarius obovata, obtusa, vel apice breviter acuminata; *petiolus* brevis, rigidus, pubescenti-tomentosus, plerumque ¼–½ unciam longus, sæpe brevissimus et folia subsessilia. *Stipulæ* deciduæ, ovatæ vel oblongo-ovatæ, obtusæ, pallide virescentes, 9–11 lineas longæ et 5–7 lineas latæ, basi truncatæ, extus molliter adpresse pubescentes, intus læves basique glandulis ferrugineis elongatis apice subu- lato-attenuatis pluriserialibus ornatæ. *Panicula florifera* ampla, subpyramidalis, rigida, foliosa: ramuli et pedicelli tomentoso-pubescentes, pallide virescentes; inferiores ascendentes; superiores patuli, subdivaricati: bracteæ lanceolatæ, cum laciniiis calycis saturate rubicundæ (vel dilute punicei), sed pube albida tectæ. *Panicula fructifera* corymbosa, magna, rigidiuscula, conferta, fructibus uberrime ornata; pedicellis dimidiam fructus longi- tudinem fere æquantibus. *Calycis* limbus subcampanulatus; dentes patuli, triangulari-lanceolati, acuti vel subacuminati, rubicundi (juniores punicei), sed pubescenti-tomentosi et pube albida tecti. *Corollæ tubus* a basi ad apicem distincte pentagonus, 5 lineas longus, basi et fauce leviter angustatus, saturate carneo-rubes- cens; intus lævis, extus sericeus juniorque pube adpressa albida velatus; anguli (intus staminiferi, laciniiis limbi alterni) extus in medio tubi prominentes et ibidem dein longitudinaliter fissi, lacinia limbi lanceolatæ, eximiae, revolutæ, superne albæ (vix roseo-albæ), subtus tubo concolores; pilis marginalibus albis, tortuoso- crispatis. *Filamenta* filiformia, alba, basi corollæ inserta, parte inferiore cum tubo connata, parte superiore libera, inferiorem et antheras longitudine æquante, vel antheris paullum longiore. *Antheræ* flavæ, partem filamentorum liberam longitudine æquantes vel paullum breviores, inclusæ, nec nisi incisurarum basin inter lacinias attingentes, rarius in fauce corollæ conspicuæ, subexsertæ; *stylus* inclusus; *stigma* antherarum basin attingens, vix superans, viridescens, bilobum, lobis oblongis obtusis erecto-patulis. *Germen* rotundum, medio depressum, viridescens, vertice leviter quinque-costato. *Capsula* ovato-oblonga vel ovato-lanceolata, 9 ad 10 lineas longa, 2 ad 2½ lineas lata, cum pedicello pubescens, in utroque latere distincte 10-costata, basi obtu- siuscula, ad apicem sensim attenuata; dentibus coronæ majusculis, erecto-patulis. *Color* rufescens, pube grisea. *Semina* elliptico- vel ovato-oblonga, ad apicem plerumque lacerato-fissa, medio subintegra, basi vulgo in apiculum serrato denticulatum subinde bifidum elongata; nucleo compresso-plano, tertiam seminis partem circiter æquante.”
—*Habitat* prope Uchubamba vicum Peruviae centralis.—*Junghuhn*, *Bonplandia*, vi. *Jahrgang*, 1858, n. 4 et 5; *Adumbratio*, pp. 98 et 99. *Conf.* p. 101, etiam viii. *Jahrgang*, p. 207: *necnon litteras ad nos a Junghuhn et Hasskarl scriptas.*

This species was first met with by Dr. Justus Charles Hasskarl (the botanist employed by the Dutch Government to collect seeds and plants of Cinchona, in order to introduce the cultivation of these into Java), in the neighbourhood of Uchubamba, on the eastern side of the second Cordillera, where

this sinks down into the low plains of Brazil, at an elevation of 5500 to 6000 feet above the level of the sea, in a very sandy, micaceous soil, on dry sunny hills, without much shelter from the sun. The plant seldom rises, in its native country, above fifteen to twenty-five feet in height, thus forming a small tree, but at times only a shrub, and in this state it is not unfrequently covered with its elegant pink flowers and reddish fruit. I have to record my thanks to the above-mentioned botanist for these details and the sight of his very interesting herbarium, also for the gift of various specimens. Amongst these I find the sort from which Dr. Hasskarl obtained the seeds which he forwarded to Java. The vernacular name of the bark is *Cascarilla crespilla chica* (small), giving thus an evident connection in the minds of the cascarilleros with the *Cascarilla crespilla grande* (great), and perhaps explaining in part the mistake into which this gentleman fell in naming it *C. ovata*. The *crespilla grande* appears to me to be indeed the *Cinchona ovata* of Weddell, in so far as I can judge by comparison with specimens so named, given to me by that distinguished botanist. I have before stated the difference between this form and the *C. ovata* of Pavon. Nothing can be more unsatisfactory than thus naming species of Cinchona from the shape of the leaves, variable as these are in that family. In the *Cascarilla crespilla grande*, the general shape, and the whole conformation of the leaves, agrees with the above-named plant of Dr. Weddell; but the large leaves collected by Hasskarl are round, a little decurrent towards the petiole, and the set of the veins indicates a tendency towards the cordate form, and approximating to that of the leaves of the *C. cordifolia* of Mutis, as gathered by Karsten.

The present species, the *Cascarilla crespilla chica*, is wholly different, when considered botanically, and is peculiarly well distinguished by the corolla, in which are five longitudinal openings, bordered with hairs, having a singular appearance under the microscope: this is a feature which, according to Junghuhn, is never wanting among a million of flowers; it seems to indicate the idea of the five leaves of which typically the corolla is formed. The specimens of Dr. Hasskarl and those which I have received from Java are so exactly the same, that no doubt could remain in any mind of the identity of the species, which nevertheless has thrown itself into two slightly divergent varieties, noticed as such in Java, and represented in the dissections in our Plate. These appear to be the *macho* and *hembra* forms of the plant, and as Dr. Hasskarl could only collect the seeds, and did not meet with the flowers, I do not know which of these is the original, or whether both were introduced from Peru. Some of Dr. Hasskarl's specimens show a greater amplitude of leaf, and a more distinctly ovate form than any which I have received from Java, as will be seen by the outline drawn by Mr. Fitch from the leaves which are the most divergent from the ordinary form. On the whole, the character of the plant is so peculiar that it could not be mistaken, even in a dried state, for any other. The smooth upper surface of the leaves contrasts curiously with the felt-like pubescence of the under surface, and the hairy capsules are probably an indication of the worthlessness of the species for pharmaceutical purposes.* In this respect and in the form of the capsules (but not of the leaves), the plant seems to me to approximate to the *C. Carabayensis*, Weddell; but the latter is a mere shrub, whilst the *C. Pahudiana* attains the dignity of a tree. It does not appear to me

* I cannot perceive however that Dr. Hasskarl was to blame in sending over this species, the value of which was unknown. In so doing it appears that he strictly followed his instructions.

to have any connection with the *C. lucumæfolia*; and since the receipt of the peculiarly coriaceous leaves of this plant which I forwarded to him, Dr. Junghuhn is quite of the same opinion. That plant is well represented in outline by Dr. Weddell, and I have not the materials, either in the specimen of Pavon's which I possess, or in those sent me by Don Riofrio, to add much to the representation which is there given, to which I therefore refer the reader, with this caution, that he must remember the character of the leaf of the *lucumæfolia*, which is peculiarly leather-like when dried, and perfectly smooth on both sides.

I have so small a quantity of the bark of the *C. Pahudiana* in my possession, that I am unable to accomplish much in chemical investigation, but the observations which I have made coincide with the published analysis of Dr. De Vrij in pronouncing it an inferior sort.* De Vrij has only obtained 0.40 of alkaloid per cent., and even less, when operating on a larger quantity of bark. This must be considered a very discouraging result, especially since the known skill of the above chemist precludes the idea of failure on his part; the large produce which he has obtained from the Calisaya bark grown in Java also tending to show that the deficiency is in the tree itself. I can moreover see no ground for the hope expressed, that this state of things will in time give place to a better.

Dr. De Vrij has been good enough to send me a very small portion of bark from the trunk of a tree of this species, which he has noted as having had a circumference of twenty-five inches; nevertheless the bark is exceedingly thin, and curls very much in upon itself in drying. It is deficient in bitter taste, though possessing a fine aroma, which may possibly secure its acceptance with the druggists.

* M. De Vrij writes me thus, from Tjiboda, isle of Java, under date September 3rd, 1860:—

"According to my first investigation, it (the bark of *C. Pahudiana*) seemed to be rather a poor bark; but you must consider that this investigation was made with bark of very young specimens. I hope, however, to be able to give you some more chemical information on this bark after two months, for I have been authorized by the Governor-General to sacrifice one tree, so that now I can investigate chemically the bark of the same tree from which I enclose specimens. . . .

"During the last month I have been occupied with the investigation of a specimen of Calisaya six years old, of which I carefully examined the bark of the trunk, of the thick and of the thin branches, all separately, and also the bark from the roots. From the bark of the trunk I obtained *five per cent. of alkaloids*, and amongst them was again the crystallizable modification of Quinine on which you have fixed my attention. I observed also the same fact long ago observed by you, that this crystallizable modification is very easily decomposed.

"The bark from the branches of the same tree contained only $2\frac{1}{2}$ per cent. of alkaloids, whilst the very thin branches contained only a fraction of one per cent."

Further particulars are given in the 'Bonplandia,' and thus condensed in the 'Répertoire de Chimie' for October, 1860:—

"Great anxiety has been felt to learn whether the Cinchona acclimated in Java contained the salutary organic bases which were the object of the enterprise. In June, 1858, M. De Vrij ascertained for the first time the presence of the alkaloids in general; but the opportunity for estimating the quantities of Quinine and Cinchonine did not arise before February, 1859. It was then necessary to cut down a tree five years old, because it had been attacked by a species of *Bostrichus*. On examination of 50 grammes of this bark, M. De Vrij found 4.31 per cent. of impure alkaloids. MM. Delondre and Bouchardat mention in their 'Quinologie' that a kilogramme of the best bark of Bolivian Calisaya gives 30 to 32 grammes of Sulphate of Quinine, and 6 to 8 grammes of Sulphate of Cinchonine. Calculated from these data, the quantity of the two bases united would be 31–2 grammes, or 3.12 per cent. We may thus suppose that comparatively the yield of the Calisaya of Java would be at least equal.

"Whilst treating 557 grammes of the Calisaya of Java, M. De Vrij has isolated Sulphate of Quinine, Cinchonine, Quinidine, and he has also found a fourth base, which he calls Crystallized Quinine. . . .

"The researches on the *Cinchona Calisaya* were followed up by those on the *Cinchona (Pahudiana)*. This bark also yields Ammonia. The amount of the impure organic bases only reached 0.40 per cent., but the result was still less in the trial of 600 grammes. For the time being, they flatter themselves that the older plants will give a better produce.

"In reference to the substance which separates spontaneously from the alkaline mother-liquor, in crystals in form of a cauliflower, M. De Vrij is of opinion that it is a modification of Quinine. He calls it Crystallized Quinine, because the following reactions testify its identity:—The crystals are very soluble in alcohol and ether; they melt at 35° centigrade, and change at 45° into a consistent mass resembling turpentine; the alcoholic solution is levogyrate in its polarization; with alcohol, sulphuric acid, and iodine they form beautiful crystals; its sulphate is scarcely to be distinguished from the ordinary sulphate; it produces with the iodohydric acid an uncrystallizable neutral salt."

It contains apparently much colouring matter, and imparts a fine red tint to the solution of potash used in boiling the microscopical sections.

When submitted to dry distillation, it does not give the fine carmine colour common to all barks containing a large proportion of alkaloid. This must be considered *negatively* as very decisive; though the presence of this colour would not be sufficient to rest upon *affirmatively* in deciding upon the commercial value of a specimen of bark. I find *no* red colour in the bark in my possession from Java, and scarcely a trace in that which I received from Dr. Hasskarl, as gathered by himself at Uchubamba, and which corresponds well with the bark grown in Java, with the exception of its having been taken from a more healthy tree.

The microscopical examination of the specimen from Java shows a bark remarkable chiefly for the tender structure of the cellular tissue of the liber, combined with very well-formed and strong cortical fibres, which are not readily cut without being torn out of their places, rendering much care needful in forming the section. The whole of the bark is gorged with colouring matter, and even when boiled with potash, this is seen remaining in little knots of a character unusual, and perhaps resulting from disease in the tree. The medullary rays are partly filled with coloured resin, as is to be noticed in Red Bark.

The structure of the specimen from Peru is similar in its general features to that from Java, except in the greater number and stronger development of the cortical fibres.

Dr. Junghuhn mentions (see 'Bonplandia' of July, 1860) his object in sending me the very ample and beautiful specimens of this plant which I have received from him, in order that I might describe the species, if I was satisfied of its being really a new one, in the present work. Through the minute supervision which this gentleman exercises over the culture of Cinchona-trees in Java, it has come to pass that we are at this time better acquainted with the *C. Pahudiana* than with almost any other member of the family, and find ourselves in a position to speak confidently of its claim to a separate identity in our description. The materials placed at my disposal have removed all the doubts which I at first entertained on this point, Dr. Junghuhn having even taken the pains to send me over flowers preserved in spirit of wine, that I might investigate the more fully their peculiar character: whilst to Dr. Hasskarl we owe the solution of another question, whether indeed this might not be a new variety, originated by change of climate and soil. This can now be as decidedly answered in the negative, as the plants grown from seed sent by Dr. Hasskarl are identical with the mother plants from which these were taken in Peru.*

With the concurrence, and at the suggestion of the Dutch botanist Junghuhn, I have much pleasure in conferring upon this plant the name of M. Charles F. Pahud, the Governor-General of the Dutch possessions in the East Indies, to whom we are greatly indebted for his signal services in promoting the transplantation of the *Cinchonæ* to Java. The Dutch botanists† repeatedly urged this subject on the attention of the government, but nothing was done, until at length, in 1852, this

* I have been able to raise small plants from seeds contained in the capsules sent from Java, and they are now growing in my conservatory.

† De Vriese, De Kinaboom van Zuid-Amerika overgebracht naar Java, p. 80 *et seq.*; also Hooker's Journal of Botany, vol. viii. p. 304.

gentleman, as Minister of the Colonies, proposed to the King to send some one to Peru, to bring the seeds and plants of the Peruvian Bark tree, and if possible introduce them into Java. After the seeds of several species of Cinchona had been sent to Java, he omitted nothing which was necessary to ensure their success. In 1855 the King appointed M. Pahud to be Governor-General of the Dutch possessions in the East Indies, and in this capacity he continued his care for his favourite Cinchona family. To him, therefore, we are under obligation for the knowledge of this species, which had certainly never before been described by any botanist; and I can only wish the species itself, instead of its proving, as I fear, a source of disappointment to the Dutch Government, was one more worthy to bear the name now given to it.

The introduction of the Cinchona into the island of Java appears to have experienced great difficulties, which however are now to a great extent surmounted; and this laudable experiment, so important to mankind, may be considered as crowned with success.

In the first instance the plants were placed in far too warm and low a situation* (according to Dr. Junghuhn); and the destruction of a forest of Rasamala-trees (*Liquidambar Altingiana*) left in the soil in which these *Cinchona* were subsequently planted, quantities of old roots, which became infested with a sort of dry-rot (mycelium of a *Rhizomorpha*), which was communicated to the young trees, making its way even through their structure, so as to be perceptible between the bark and the wood of the trunk.† In consequence of this, many died, and it became necessary to resort to the perilous experiment of moving the trees altogether to another plantation, higher up the mountain. This was on the whole successfully accomplished, especially in regard to the trees which had their roots carefully divested of all remains of the previous infected soil.

Another danger to the trees has arisen from an unexpected cause,‡ the attacks of a minute boring insect (a *Bostrichus* or *Dermestes*), which penetrates to the centre of the trunk, and as soon as its progeny make their way out from their central nest, the tree begins to wither and fade. This insect appears to have been imported in the soil brought from Peru with some of the bark-trees; at least, it is not known as inhabiting the surrounding woods in Java.

The one yet unsurmounted danger appears to me to be the preponderance of the present species, which threatens to occupy the attention of the cultivators to a much greater extent than its properties at all warrant.

Through the unfavourable influences above mentioned, it appears that at the end of the year 1857 only thirty-seven of the Calisaya and sixty of the present species were remaining at Tjibodas, the principal original plantation in Java; but this disproportion, even then considerable, went on increasing.

The *Cinchona Calisaya* is much more tender, and resists external unfavourable influences with much greater difficulty than the *Cinchona Pahudiana*, from which circumstance, and from the more abundant ripening and more prolific nature of the seeds of the latter, it has come to pass that at the close of the year 1859 there were, of the *Cinchona Calisaya*,—

Germinating seeds and young plants from the beds	2,401	
Little trees cultivated from seeds ripened in Java and planted in the open ground	16	
	—	2,417
Provision of old trees grown from slips	784	
	—	3,201

of the *Cinchona Pahudiana*,—

Germinating seeds and young plants from the beds	68,569	
Little trees cultivated from seeds ripened in Java and planted in the open ground	27,702	
	—	97,271
Provision of old trees grown from slips	567	
	—	96,838

* 'Bonplandia,' viii Jahrgang, p. 231.

† l. c. pp. 208, 209.

‡ l. c. p. 228.

It will thus be seen what an unfortunate preponderance has accrued to the species under description; which result is not altered by the additional few plants of other species of *Cinchona* which are grown in Java, viz. (at the same date) of

<i>C. lanceolata</i>	.	.	.	.	.	.	45
<i>C. lancifolia</i>	.	.	.	.	.	.	35
<i>C. succirubra</i>	.	.	.	.	.	.	14

I am inclined, on full consideration and comparison of the material placed under my notice with impressions received from the inspection of six hundred plants of *C. succirubra* which have been quite recently (February, 1861) in this country, on their way to the East Indies, to believe that this identification may be correct (as the form of the leaves varies much even on the same plant); but if so, we are at once furnished with a new *habitat* for the *C. succirubra*, as it has not been known as a native of the districts through which Dr. Hasskarl penetrated.

It is probable that the report at the close of 1860 will show a still more excessive preponderance, owing to the vast number of seeds of the present species set to germinate, viz. 408,230 of the *Cinchona Pahudiana*, against 11,668 of the *Cinchona Calisaya*.

NOTE.—The reader will find these particulars, with abundant additional information, in the ‘Bonplandia’ for July, 1860, pp. 237, etc. The number of *old* trees is given l. c. p. 258.

Since the above was completed, I have received from M. De Vrij a letter, dated from Bundong, Isle of Java, January 15th, 1861, in which he remarks:—“In the beginning of my investigations of the bark of Java, I must confess that, finding only 0·50 per cent. of alkaloids in the bark of *C. Pahudiana*, I expressed to my friend Dr. Junghuhn my opinion that I feared the bark of this species would prove to be not valuable. Since that time, however, my opinion is much altered, so that at present I suppose it may be possible that the bark will be better than I thought beforehand.” The reason for this altered judgment is given by Dr. De Vrij in the particulars of several analyses since made, and which will no doubt be published by himself, leading to this general result, that “*the value of the bark from this species is still uncertain, and only to be ascertained by the investigation of the bark from several trees grown under different circumstances.*”



CINCHONA UMBELLULIFERA, Pavon.
Cascarilla crespilla de Jaen, et Cascarilla fina de Provincia.

CHINCHONA UMBELLULIFERA.

CHINCHONA UMBELLULIFERA, foliis oppositis, petiolatis, ovalibus oblongisque, paniculâ coarctatâ, pedunculis partialibus, floribus umbelluliferis congestis.

Arbor 10–12-orgyalis. *Truncus* erectus, teres, solitarius, comâ frondosâ, ramosâ. *Cortex* subniger, asper, sapore valde amaro, acidulo, non ingrato, virtute præcellenti pollet; in commercio et in medicina magno usu fit. *Rami* oppositi, brachiati, tetragoni, angulis acutis, erecti. *Folia* opposita, petiolata, subdecurrentia, ovalia oblongaque, nonnulla obovata, supra glabra, obscure viridia, nitida, dependentia, nervosa, venosa, venis reticulatis, nervo centrali purpureo, subtus villosa, per nervos præcipue et venas, apice obtusa, marginibus revolutis, glandulis solitariis, subtus concavis, rotundatis, ad axillas nervorum insertis, margine villosis, villis albicantibus, minimis, supra prominentibus; *superiora* minora, ovalia oblongaque, obtusa, nonnulla lanceolata. *Petioli* breves, basi incrassati, subteretes, villosi. *Stipulae* duæ, oppositæ, interfoliaceæ, supra-axillares, erectæ, cauli appressæ, oblongæ, glabræ, nervo centrali prominente, deciduæ. *Pedunculi communes* axillares terminalesque, paniculati, oppositi, patentes, villosi, teretes partiales; *bracteis* duabus oppositis, subulatis, ad basin insertis partis. *Pedicelli* teretes, pubescentes. *Flores* pedicellati, in umbellulas congestas dispositi; *bracteolis* parvis, oppositis, subulatis, ad basin et in medio solitariis, insertis. *Calyx* parvis, quinquedentatus. *Corolla* grisea, parva, extus pubescens, laciniis intus villosis, villis albicantibus. *Antheræ* lineares, luteæ, fauci inclusæ. *Cap-sula* ovalis, ventricosa, pubescens, calyce coronata, striata, basi hians, purpurascens. *Semina* oblonga, alâ lanceolatâ inæqualiter lacerâ.—*Habitat* in collibus nemorosis, Jaen Provinciâ. *Floret* Junio, Julio, et Augusto. *Vulgo*, *Cascarilla crespilla*, et varietas *Cascarilla fina* de Provinciâ.—*Pavon*, *Nueva Quin.* sub sp. 40.

Our Plate is drawn from a fine specimen at Madrid, marked “*Casc. crespilla*, F. P. No. 592, L. 746, *Cinc. umbellifera*, ex Jaen.”

There is also a fine specimen of this species (which Dr. Klotzsch remarked to me as being very peculiar) in the botanical collection at Berlin.

The bark is called the “*Cascarilla Provinciana fina*,” and is represented No. 33, Woods, B. Museum; also a variety, “*Cascarilla crespilla* de Jaen de Loxa,” No. 13, Woods. These are alike silvery barks, with pimpled surface. Similar pieces may easily be found among the finer samples of *grey bark*, but I am unable to describe the bark as a markedly distinct sort.



W. Eitch del. et lith.

W. West imp.

CINCHONA DECURRENTIFOLIA, Pavon.
Cascarilla crespilla ahumada.

CHINCHONA DECURRENTIFOLIA.

CHINCHONA DECURRENTIFOLIA, foliis oppositis, petiolatis, obovato-subrotundis, ovatis ellipticisque, decurrentibus, pediculis paniculatis, corollis puniceis.

Arbor 4–5-orgyalis, solitarius, erectus, teres, comâ frondosâ, ramosâ. *Truncus* erectus, teres, ramosus. *Cortex* levis, cinereo-virescens, ad pallidum colorem referens, præstanti amaro sapore, non ingrato, in febris tertianis propinari potest. *Rami* tetragoni, obtusi, cortice pallido cum nonnullo purpureo colore. *Folia* opposita, petiolata, obovato-subrotunda, ovata ellipticaque, cum brevissimo acumine, integerrima, undulata, decurrentia, glabra, superne viridiora, nervosa, venosa, seniores subtus purpurea, nervis venisque puniceo colore. *Petoli* breves, subteretes, basi crassiores, punicei coloris. *Stipulae* duæ, oppositæ, interfoliaceæ, sessiles, cauli adpressæ, ovatæ, integerrimæ, marginibus revolutis, subcordatæ, nervo centrali prominente, deciduæ. *Pedunculi communes*, axillares terminalesque, paniculati, foliosi; *partiales* bracteis duabus oppositis, subulatis. *Pedicelli* breves, bracteolis solitariis, minimis, ovatis ad basin, et in medio pedicellorum persistentibus. *Flores* nonnulli, sessiles. *Calyx* quinquedentatus, denticulis subrotundis, purpureus, pubescens, albicans. *Corolla* puniceo-rubra, pubescens; *laciniis* reflexis, intus villosis-tomentosis, villis albicantibus, odore aromatico gratissimo, fructus *Vanillæ* simili fere. *Antheræ* extra faucem parum exsertæ, basi subsagittatæ, flavæ. *Capsula* oblonga, bipollicaris, basi hians, ex puniceo rubro colore, nonnullæ capsulæ ab insectorum punctione figuram globosam sumunt, et monstrosæ fiunt. *Semina* ceteris speciebus simillima.—*Habitat* in collibus *Angamuna*, prope Yangana, Vilcabamba ditone, Loxâ Provinciâ. *Floret* Junio, Julio, et Augusto. *Vulgo*, *Cascarilla crespilla ahumada*.—*Pavon, Nueva Quin. sub sp.* 26.

The bark of this species, the *Cascarilla crespilla ahumada de Loja*, is rarely met with in commerce. It is more fibrous in its structure than the pale Jaen bark, and is remarkable for a peculiarly greenish-white and rusty epiderm, which has (I suppose) occasioned the name “smoky” (*ahumada*) to be applied to it. The bark has some resemblance to that of the *C. Pelletierana*, Wedd., but much more entirely agrees with that of the *C. purpurascens* in my possession, given me by Dr. Weddell. I suspect, from the concurrence of the descriptions in several points, that these two species coincide. The decurrent leaves, purple on the under surface, and the preference shown by insects for this plant, are points of agreement which can scarcely be accidental; and the great resemblance of the barks strongly corroborates the view I have above expressed.

A specimen brought by Jos. de Jussieu, under the name “Kina-kina à écorce blanche de Loxa,” accords well with this or with *C. Pelletierana*. The bark is now called *Cascarilla blanca* in Peru. My specimen was recognized by M. Guibourt as *Quinquina blanc de Loxa*. It appears to me to coincide very nearly, when examined microscopically as well as in its obvious features, with the *blanc fibreux de Jaen* of the same author. This should be the bark from which Manzini obtained *cinchovatine*, which appears to be the same alkaloid as *aricine*, obtained from the very nearly allied tree *C. Pelletierana*, as will be seen by the following extract from the tenth *livraison* of M. Gerhardt’s ‘*Traité de Chimie*,’ p. 152:—“Cet alcali a été découvert par Pelletier et Corriol dans un *Quinquina blanc*, venu d’Arica à Bordeaux. M. Manzini l’a extrait, il y a quelques années, du *Quinquina blanc fibreux de Jaen*; mais croyant avoir trouvé un alcali nouveau, il l’a décrit sous le nom de *cinchovatine*. L’identité de l’aricine et de la cinchovatine a été mise en évidence par M. Winckler.”

Microscopically considered, the bark is remarkable for the great size of the woody fibres of the liber, as seen in our drawing of a section.



W. Eitch del. et lith.

W. West imp.

CINCHONA OBOVATA, Pavon.
 1. C. Discolor, Klotzsch.
 2. Cascarilla Hoja de Oliva, Pritchett.

CHINCHONA OBOVATA.

CHINCHONA OBOVATA, foliis oppositis, petiolatis, obovatis, pedunculis paniculato-corymbosis, terminalibus; calycibus floribusque rosaceo-rubicundis.

Frutex bi-orgyalis, parum ramosus. *Truncus* erectus, cortice cinereo-nigrescente aspero levique obductus; comâ ramosâ. *Rami* erecti, teretes, teneri obtuse tetragoni, pubescentes, apice foliosi, purpurascens. *Folia* opposita, petiolata, obovata, undulata, integerrima, acumine obtuso, marginibus revolutis, supra glabra nitidaque, subtus pubescentia, maxime nervosa venosaque, venis reticulatis, nervo centrali venisque purpurascens. *Petioles* teretes, superne canaliculati, basi incrassati, rubicundi. *Stipulae* interfoliaceae, oppositae, oblongae, integerrimae, undulatae, erectae, cauli adpressae, nervo intermedio crasso prominente, obtusae, deciduae. *Pedunculi communes* terminales, foliosi, oppositi, paniculato-corymbosi; *foliolis* oppositis, petiolatis, ovatis, integerrimis, obtusis. *Pedicelli* oppositi, 3-4-flori, bracteolis parvis, ovatis, concavis, acutis, in medio et ad basim singuli florum pedicelli oppositi et solitarii. *Calyx* rubicundus. *Corolla* rosaceo-rubra, laciniis intus villosa-tomentosis, villis albicantibus; *tubus* incurvatus. *Stam.* *Filamenta* quinque, aliquando sex. *Antherae* lineares, intra tubi faucem. *Capsula* lineari-oblonga, bilocularis, bivalvis, a basi dehiscens. *Semina* ut in ceteris speciebus.—*Habitat* in altis frigidis locis, Carpis nominatis, Chinchao vico silvis. *Floret* Julio et Augusto.

This species, of Pavon, appears to be identical with the *Cinchona discolor* of Klotzsch, a specimen of which was given me by that botanist at Berlin, in the year 1857, with an inscription in the handwriting of Poeppig, as follows:—"Cinchona pubescens, Vahl, *δ. heterophylla*, DC. iv. 353. *Flor. Peruv. In summitate Cuesta de Carpis inter Acomayo et Chinchao. Apr. 1830.*" To this was also added the following information from Klotzsch himself:—"Cinchona discolor, Klotzsch. *Arbor* 12-18. *Cortice albido. Flor. roseo-purpureis, limbi villis candidis. Cascarilla hoja de Oliva incol.*" I advised Mr. Pritchett to look out for this sort in the above locality on his arrival in the Huanuco district, and he accordingly obtained specimens, from the Cuesta de Carpis, both of the plant itself and of the bark belonging to it. The latter, if indeed it were the *Cascarilla con hojas parecidas á las del Olivo* of Ruiz, ought to be a valuable sort, indeed the best of all, according to the estimate formed by Poeppig of the relative worth of these products. His description is as follows:—"The bark is only obtained in small broken pieces, and is not gathered by itself. It coincides with the finest sorts of Loja bark, but exceeds these in resinous qualities and in bitter taste. The tree, which is unknown to me, grows only on the coldest mountains, makes an erect stem barely eight feet in height, and yields very little bark, but which was so much prized, that the viceroys and corregidors sent it alone as a present to the king and nobles of Spain. It never appears in trade. The flower is of the deepest red, furnished in the interior with snow-white wool, and unfolds itself in May. These last characteristics agree well enough with a Cinchona which I found as a very small tree in April, 1830, on the Cuesta de Carpis, the *Chinchona heterophylla*, Ruiz, a sort distinguished by its pendent flowers, which might more probably be a variety of *C. pubescens*, Vahl."

I see no reason to doubt the identity of this species found by Poeppig with that of Pritchett,

* Poeppig, Reise, vol. ii. p. 261.

and of both with the *Chinchona obovata* of Pavon; but I hesitate to believe that they represent the origin of the *Cascarilla con hojas del Olivo*, since I can neither trace any sufficient resemblance in the leaf to that of the Olive, nor can I find that the description of the bark agrees with that brought home by Pritchett, which seems to constitute a variety of the *C. pubescens*, and yielded me on examination, together with an intensely yellow-coloured resin and some kinovic acid, a well-marked product of aricine, forming, as sulphate, the peculiar trembling jelly instead of crystallization which distinguishes that alkaloid. From the same district Mr. Pritchett obtained also a leafy branch of *C. ovata*, Pavon, with the bark belonging to it, called there *lengua de vaca*, which gave the cognate but not so well defined product of *Paracine*, verging thus towards the allied families in which this is found.

Mr. Pritchett informs me that "the *Pata de Gallinazo* and the *Hoja de Olivo* are reported as abundant in the woods to the south of Cocheros." It is evident, however, that the bark of the present species can never become of any importance in commerce.



W. Fitch del et lith.

1. CINCHONA STUPEA, Pavon.

Cascarilla estoposa.

2. CINCHONA LANCEOLATA.

Cascarilla lampigna.

W. West imp.

CHINCHONA STUPEA.

CHINCHONA STUPEA, foliis oppositis, petiolatis, lanceolatis, integerrimis, obtusis, nervosis, venosis; panicula brachiata. *Arbor* 3-4-orgyalis, comâ frondosâ. *Truncus* solitarius. *Cortex* extus fuscus, maculis albicantibus, rimis profuse transversalibus, intus cedri coloris, stupeus. *Rami* oppositi, brachiati, tetragoni, angulis acutis. *Folia* opposita, petiolata, lanceolata, integerrima, obtusa, nervosa, glabra, venosa, nervo centrali coccineo. *Petioles* subteretes, pollicares. *Stipulae* oppositæ, interfoliaceæ, supra-axillares, ovales, integerrimæ, glabræ, deciduæ. *Panicula* brachiata, axillaris terminalisque. *Pedunculi* multiflori, tetragonales. *Pedicelli* bracteolis lanceolatis, sessilibus, acuminatis, in medio et ad eorum basim suffulti. *Calyx* campanulatus, quinque-dentatus, persistens. *Corolla* pallescens, laciniis intus hirsuto-tomentosis, villis albicantibus. *Capsula* ovalis, striata, striis longitudinalibus, glabra, bilocularis, bivalvis, a basi ad apicem dehiscens.—*Habitat* in montibus (vulgo, del Pan y de Hualasco) Cuenca et Loja Provinciarum. *Floret* Junio, Julio, et Augusto. *Vulgo* Cascarilla estoposa.—*Pavon*, *Nueva Quin.* sub sp. 5.

The bark of this species has occasionally formed part of importations of “ashy crown bark” from Peru. More generally it is found in serons unmixed, but often in company with parcels of the above bark. It grows at a higher elevation on the mountains than the *lanceolata* or *lucumæfolia*, though it appears to be confounded with both under one common appellation of “*hojas de Lugma*.” M. Riofrio, my informant, says “there is a good deal of this kind, or rather, we should say that *hoja de Lugma* of good quality is naturally ‘estoposa’ (like tow, or fibrous), as is also the *hoja de Capuli*.”*

There is, however, a very marked difference between the bark, as well as between the trees of these three varieties; only the *small* quills of the *lanceolata* and *estoposa* resemble each other. I extract the description of the *estoposa* bark from page 13 of my previously published “Examination,” as still confirmed by observation and by Pavon’s specimen in my possession.

“The small quills are so entirely covered with various cryptogamous plants, that they present a similar *facies* to that of the bark with which it was imported. The larger quills are more silvery, with a periderm in some cases partially exfoliating, and leaving the light brown surface of the derm covered with transverse furrows, forming a close imitation of the *C. rufinervis*, Weddell. From this bark it is at once distinguished by its ‘entirely fibrous’ character, and this feature, with the silvery, fretted, and mottled surface of the periderm, induce me to think the bark the same as the No. vi. *Lagartijada* of Laubert. It would, at least, be difficult to find a term more descriptive of the appearance of the larger quills. Some of these attain a length of twenty inches, and a diameter of from half an inch to an inch.”

* I am not able to assign the specific name of this sort. The leaf, as sketched for me by Don Riofrio, might be that of *Cinchona stupea*, but still more resembles specimens gathered by Hasskarl of a hitherto undescribed species.

In the collection at Kew are two specimens collected by Jameson, labelled—

“No. 27, *Cinchona* — near Guachapala, on the eastern side of the Cordillera, elevation 8500 feet.”

This is either the *C. lanceolata* or *C. macrocalyx*. The specimen is an imperfect one.

“No. 28, *Cinchona* —, with the preceding species, but rather higher elevation. Named by the inhabitants *Cascarilla estoposa*, from the bark splitting into fibres like tow.”

This last is evidently the *C. stupea* of Pavon.

“El Pan and Hualasco” are assigned by Pavon as the *habitat* of this species, and I suspect the superior quality of the “hoja de Lugma” bark from El Pan (mentioned by Don T. Riofrio) arises from its being the product of this species.

Hualasco appears on the maps at a short distance east from Cuenca.

CHINCHONA LANCEOLATA.

CHINCHONA LANCEOLATA, foliis oppositis, petiolatis, lanceolato-oblongis, glabris; panicula brachiata; floribus subcorymbosis.—*Cascarillo lampiño*, Ruiz, *Quinologia*, Art. 4, p. 64.

Arbor 6-orgyalis, glaber, comâ frondosiusculâ patulâ. *Truncus* solitarius, sæpe plures, erecti, teretes, crassi. *Cortex* extus fuscus, parum variegatus, vix scaber, intus lutescens, præcedentibus et sequentibus amarior, acidulus non ingratus. *Rami* teretes, erecto-patuli; *juniores* foliosi, obtuse tetragoni, secundum articulationes vix compressiusculi. *Folia* opposita, petiolata, lanceolato-oblonga ovali-oblongaque, integerrima, plana, patentia, utrinque glaberrima, subtus venosa, venis purpureis, folia superiora ovata. *Petioles* semipollicares, purpurascens. *Stipulæ* oppositæ, interfoliaceæ, supra-axillares, ovatæ, obtusæ, planæ, adpressæ, basi coadunatæ, deciduæ. *Panicula* terminalis, magna, brachiata, composita, foliifera. *Pedunculi* multiflori, subcorymbosi, tetragulares. *Pedicelli* bracteolis subulatis deciduis suffulti. *Calyx* purpurascens, brevis, quinquedentatus, persistens. *Corolla* roseo-purpurea. *Limbus* hirsutus, patens. *Stamina* infra medium tubi inserta, basi hirsuta. *Capsula* oblonga, angusta, fere pollicaris, leviter striata, calyce coronata, a basi ad apicem hians, rubro-fusca. *Semina* ovalia, fulvescentia, margine oblongo helvolo obsolete lacero-dentato cincta.—*Habitat* in Andium montibus altis, frigidis, et nemorosis, ad Muña, Pano, Pillao, et Cuchero tractus. *Floret* a Maio ad Octobrem. *Vernacule*, *Cascarilla bobo amarillo*, sive *Quino bobo amarillo*, propter corticum colorem internum.—*Obs.* 1. Cortices sapore amarissimo et colore Quinæ de Calisaya nuncupatæ maxime æmulantur. *Obs.* 2. In montibus Muña hanc *Chinchonam* anno 1786 offendimus.—*Vires et Usus*: Cortices ad febres intermittentes propter ejus eminentem amaritudinem magno usu in medicina usurpantur.—*Pavon*, *Nueva Quin. sub sp.* 4.

Pavon's botanical specimens of this species are so imperfect, that it is not possible to produce from them any better delineation than that which is found in plate ccxxiii. of the 'Flora Peruviana.' There is still remaining in the Museum at Madrid the portion of a branch covered with leaves, which may have served for that drawing, but the buds or flowers have perished. I have now before me several specimens of apparently the same species, gathered in 1853 by Dr. Hasskarl on the Escalera de San Rafael, on the road to Jauja, near Uchubamba, which tend to supply this deficiency. Dr. Hasskarl ranged these under the head *C. Condaminea*, Wedd., attributing them in part to the var. *δ lancifolia*, which in some respects they much resemble. Nevertheless the differences are striking, especially in the broad membranaceous character of the leaves, forming dense tufts at the end of the branches, and the character of the capsules, as of the whole plant, and also the bark brought with it

by Dr. Hasskarl is more coarse and unpromising. Notwithstanding these appearances, and the decidedly unscrobiculate character of the leaves, I am inclined to believe that it belongs to the more useful sorts. This is certainly the case, if bark which I have found in commerce corresponding to the description given by Pavon is really of this derivation; but the paucity of specimens does not admit of my speaking with certainty, although Ruiz's description, that "when stripped of the epidermis it appears like a true piece of Ceylon cinnamon," as well as the general resemblance to the Calisaya, suits this sort exactly. It was brought *viá* Callao in 1852. I do not think that any comes now from the region to which that port gives access, and which is that indicated by Pavon as the habitat of the *Cinchona lanceolata*.

There are two characteristic features of the Calisaya which the bark I am describing possesses, which make it easy to understand how the origin of the Calisaya might be supposed to be traced by M. Ruiz to this bark. I allude, in the first place, to the easy exfoliation of the periderm (a characteristic feature of the *Lampigna*, according to the 'Quinologia'), and the resulting aspect of the flat pieces, which are marked by *conchas*, almost as well pronounced as in many specimens of the true Calisaya. The second feature in which this bark approaches the Calisaya is found in the multitude of little prickles which insert themselves into the skin, when the bark is handled as it comes from the serons in which it is packed. This feature is not *confined* to these two barks, but is peculiarly and disagreeably prominent in them.

I may add a third feature, manifested in the rough surface of some of the quills,* which would almost pass without observation as Calisaya, if mixed with some of the finer sorts; but the smooth cellular tissue which lies beneath this, as well as the generally fibrous character of the bark, show that its real connection is with the *Cinchona lancifolia*, Mutis, rather than with the *Cinchona Calisaya*, Weddell. In some quills the rough surface is superseded by the smooth cellular tunic, giving the bark the glabrous appearance to which Ruiz attached the epithet "*glabra*" in the description referred to.

The bark above described gave Quinine 1.17, Cinchonine 0.05 per cent. It differs therefore from the product of *Cinchona lancifolia* in containing a much larger proportion of Quinine and a smaller of Cinchonine. M. Delondre attributes to a similar bark, which he calls *Quinquina Carthagene ligneux*, a rather larger product, equal to 1.50 per cent. of alkaloid, and entirely of Quinine.

* Ruiz calls it "superficie escabrosa y casi sempre resquebrajada" (Quinologia, p. 65).



W Fitch del. et lith.

W West imp.

CINCHONA GLANDULIFERA, Pavon.

CHINCHONA GLANDULIFERA.

CHINCHONA GLANDULIFERA, foliis oppositis, petiolatis, ovato-lanceolatis, subtus glandulosis, pedunculis paniculatis, corollis albido-roseis.—Flor. Per. vol. iii. p. 1. ic. ccxxiv. *Cascarillo glanduloso*, Quinol. Supplem. Art. 13. p. 5. *Frutex* biorgyalis, erectus, comâ ramosâ, frondosâ. *Trunci* 2–4, crassitie tripollicari, teretes. *Cortex* extus albido-cinereus, maculis fuscis nigrescentibusque variegatus, scaber, intus dilute helvolus, amarissimus, gratus, aromaticus, valde acidulus stypticusque, non viscosus, in febris tertianis usurpari potest. *Rami* erecti, teretes; juniores parum compressi, obtuse tetragoni, sulcati, purpurascens, villosa-tomentosi, molles. *Folia* opposita, petiolata, ovato-lanceolata, nonnulla lanceolata, integerrima, undulata, marginibus reflexis; supra nitida, glaberrima, dilute viridia; subtus villosa-tomentosa, præcipue ad nervos et venas, glandulis parvis, rotundis, subtus concavis, supra prominentibus, ad sinus nervorum ortum, villis longis plurimis vestitis. *Petioles* teretes, brevissimi, canaliculati. *Stipulae* interfoliaceae, supra-axillares, duae, oppositae, basi coadunatae, cauli adpressae, oblongae, acutae, subtus villosae, deciduae. *Pedunculi communes* paniculati, terminales axillaresque, tetragoni, villosi, quadrisulci. *Panícula* coarctata; *partiales* consimiles, villosi; *bracteis* duabus oppositis, linearibus, longis, hirsutis, ad basim deciduis. *Pedicelli* brevissimi, bracteolis solitariis, pubescentibus, subulatis, ad basim et in medio deciduis, suffulti. *Flores* nonnulli, sessiles. *Calyx* purpureus, denticulis subulatis. *Corolla* extus glabra, albido-rosea, laciniis intus villosa-tomentosis, villis albicantibus. *Capsula* oblonga, parva, post seminum effusionem nutans, bilocularis, bivalvis, valvulis basi hiantibus. *Semina* fulva, membranâ scariosâ tenui cincta.—*Habitat* in Peruviae Andium montibus nemorosis, ad Chicoplaya runcationes, *carpales* dictus. *Floret* Februario et Martio. *Vulgo*, *Cascarilla negrilla*.—Pavon, *Nueva Quin. sub sp.* 30.

I have retained for this species the name first conferred by Ruiz and Pavon, although Pavon, in the 'Nueva Quinologia,' altered this to a new designation, thus involving some confusion in his samples of bark with those of the *Cinchona villosa*.* I am therefore compelled to resort to the description of Poeppig as to the character of the bark. He tells us† that the *Cascarilla negrilla* comes from *Cinchona glandulifera*, R. Pav., and passes for the finest sort. The tree inhabits only the higher mountains; is scarcer than the other species; forms a stem from twelve to fifteen feet in height, and on the coldest mountain-tops becomes a bush, and yields so little bark, that only five or six pounds can be collected from a single bush. This bark is distinguished amongst the Peruvians by a prevalent blackish epidermis, which only in places is variegated by very small, when freshly-gathered, grey-greenish lichens. The common people take the last for an integral part of the bark, and especially prize this when it reveals beneath the larger lichens a shining black velvet-like substance, in ovals of some lines in width (apparently a byssus). The quality of this bark is, according to the cascarilleros, ascertained by a glassy, shining, almost resinous fracture. It should have on the inner side the colour of a ripe orange, with a slight transition to fiery-brown. The flowers spread abroad much fragrance through the woods in February.

* I received from Dr. Klotzsch a specimen from the collection of Pavon, bearing the inscription "Sp. 30, *Cascarilla negrilla*, *C. undulata*, olim *glandulifera*. No. 589, ic. 743. Estas cortezas las envió Tafalla de los montes de Chicoplaya de Peru. Se cria en los carpales, y se conoce con el nombre de *Cascarilla negrilla*." The specimen of fruit-bearing branch referred to as No. 589 ic. 743, is at Kew, and is marked there *Cascarilla peluda Jaen*. It is the identical plant of *Cinchona villosa* from which our drawing has been made, and is described, as the reader will find, under that head.

† Reise, t. xi. p. 261.

I do not possess any bark from Pavon's collection which I can consider as belonging to the present species, and those which I have, as gathered by Poeppig, appear to me of too uncertain an origin to rest any description upon. Especially am I inclined to this opinion, because I learn from Mr. Pritchett that the bark of the small branches of the *C. nitida* is also called *Cascarilla negrilla*; and if this was also the case in Poeppig's time, a confusion might easily arise. It is at least certain, that from some cause the specimens of bark brought by this celebrated naturalist do not correspond to the description he has given.

I am consequently unable to give any further account of this sort of bark, although it would be interesting to trace the chemical constituents of a species which differs so widely in its elongated spike and almost sessile leaves from other *Cinchonæ*; whilst, on the other hand, the small and well-formed capsules might seem (if it were not for their pubescence) to claim for it a place amongst the more productive sorts.

In so far as the information received from Mr. Pritchett extends, the bark of the *C. glandulifera* seems to have disappeared from commerce.



W. Fitch del et lith.

W. West imp.

CINCHONA PERUVIANA, Howard.
Cascarilla Pata de Callinazo.

CHINCHONA PERUVIANA, *Howard.*

CHINCHONA PERUVIANA, foliis oppositis, petiolatis, lanceolato-ovatis, basi attenuatis, junioribus lanceolatis, scrobiculatis, paniculâ terminali compositâ.

Arbor procera . . . *Lignum* compactum, luteum. *Cortex* extus scaber, rimosus, corticem *Calisayæ* maxime æmulans, sæpe ex albo et cinereo colore variegatis; intus obscure fulvus, amarus, fragrans. *Folia* opposita, petiolata, lanceolato-ovata, nonnulla lanceolato-obovata, alia elliptica, basi attenuata, obtuse acuminata, juniora lanceolata, scrobiculata, scrobiculis supra valde prominentibus, nitida, subtus venosa. *Petioles* subtus semiteretes, supra planiusculi. *Panicula* terminalis, composita, pyramidalis. *Capsula* oblonga, leviter decemstriata, calyce coronata, bivalvis, valvulis basi hiantibus. *Semina* ovalia, alis membranaceis, valde laceratis.—*Habitat* in Andium montibus frigidis Cocheros aliisque tractibus. *Vulgo* *Cascarilla Pata de Gallinazo*. *Obs.* In commercio magno usu fit.—*How.* *Speciminibus nobis à Pritchett datis descript.*

This tree grows in the wooded regions of Cocheros and other parts of Peru, at a lower elevation than the *Cinchona nitida*. Its general aspect must be very pleasing, with its bright white and variegated bark, and elegantly formed and glossy leaves, changing towards their decadence into a rich scarlet. It seems to be very abundant, since it yields a plentiful supply of *Grey Bark* to commerce, the finer samples now imported belonging apparently to this sort. I have consequently thought the name which I have chosen most fitted to express its character. The bark itself, as presented to me in beautiful perfection by Mr. Pritchett, corresponds exactly with the *Cascarilla Pata de Gallinazo*, a specimen of which is before me, “from the Cinchona forests of Cuchero (Cocheros), by Pœppig, in 1829.” It is still known by the same name in that district as one of the three useful sorts of Peruvian bark; the *lustrosa*, which I have described under the head of *Cinchona nitida*, and the *provinciana*, under that of *Cinchona micrantha*, forming the other two.

The present sort is in some of its characteristics intermediate between the two others. It is less rough and knotty on the external surface than the *lustrosa*, but much less smooth, and marked with much deeper cross-clefts than the *provinciana*, which latter partakes of a prevalent glaucous-green tint: this in the *Pata de Gallinazo* is superseded by white as the predominant colour, diversified by an ashy-grey tint, and by the brown rings marking out the territory of different *Sarcographæ*, *Graphideæ*, etc., also in other parts by the foliaceous covering of adherent *Parmeliæ*. In the *lustrosa* the bark occupies about one-tenth of the diameter of the section of the branch, in the *Pata de Gallinazo* about one-twelfth, and in the *provinciana* barely one-twentieth. This, of course, produces a considerable difference in the appearance of the quills, as the last-mentioned curl in much more upon themselves whilst drying than those of the other two sorts; and it is this *provinciana* bark which, as I have mentioned under the head *C. micrantha*, forms by far the larger portion of the importations of Grey Bark from Peru. The most striking peculiarity of the present sort is its resemblance in the whole of its external aspect to that of the *Cinchona Calisaya*. I am unable to point out any feature

on which it would be absolutely safe to rely in distinguishing the present bark from some varieties of the latter; although the manner in which Grey Bark is sliced from the tree, exposes an oblique section of the bark itself, which is not usual in the *Calisaya*; and the adhesion of the red lichen *Hypocnusus rubrocinctus*, frequent on the *Calisaya*, is, I think, never seen on Grey Bark. The chemical constitution of the two is however entirely different.

The predominant feature of the *Calisaya* bark is, as is well known, its abundant produce of Quinine, combined with a large proportion of Cinchotannic Acid, which is present in much feebler proportion in that of the present species.

The *Cascarilla Pata de Gallinazo*, as brought by Mr. Pritchett, yielded me a free crystallization of a salt equal (*as sulphate*) to two per cent. of the weight of the bark. This presented characteristics which induced me to regard it as the Cinchonidin of Wittstein; and after re-crystallization, I combined a portion with Iodine, forming beautiful orange plates of the iodo-sulphate, which tended to confirm my conjecture; but in order to arrive at greater certainty, I sent a portion to Dr. Herapath (who had previously examined for me Cinchonidin sent by Wittstein himself), and he kindly sent the following reply:—"The orange crystals you have sent me are decidedly those of the Cinchonidin of Wittstein, agreeing, as they do, in every particular."*

The mother-liquor remaining from the crystallization of the Sulphate of Cinchonidin gave a precipitate of 1.46 per cent. rough alkaloid, of which nearly 1 per cent., insoluble in ether, gave, on purification, fine crystals of Cinchonine.

The total produce may therefore be considered as amounting to three per cent. of the weight of the bark, comprising chiefly Cinchonidin and Cinchonine, and consequently indicating a considerable amount of febrifuge power, with variations of tonic and other coincident effects, from the very differently constituted barks of Loja; which diversity seems to me well worth the study of the medical world in reference to medicaments so largely in use.

To the present species must be referred that which I have before published in reference to "the finest Grey Bark," and which has been adopted by Pereira in his 'Materia Medica.'† We then united in considering this bark as the product of the *Cinchona nitida*, guided chiefly by the specimen amongst the sections of branches in Pavon's collection in the British Museum, sent apparently to him by Tafalla, and thus designated by him. If this be really from the *Cinchona nitida*, it must at times approximate much more closely to the present species than is manifest from Mr. Pritchett's specimens; but on the whole I am inclined to believe that the two were confounded by Tafalla, and that the *Cascarilla Pata de Gallinazo* excludes the *lustrosa* from modern importations.

* It must be understood that the Cinchonidine of Pasteur gives a wholly different compound, as the reader will see from the following extract from the 'Proceedings of the Royal Society' for November 26, 1857, Abstract, p. 17:—"The Cinchonidin of Wittstein of Munich is a totally different alkaloid [from that of Pasteur, previously mentioned], giving with Sulphuric Acid and Iodine a salt at once to be distinguished by the eye from either of the two iodo-sulphates described, but yet possessing optically doubly absorbent powers. This salt has a deep orange-yellow colour, by transmitted light merging into sienna-brown, in thicker plates, which are generally flat, and much imbricated in the method of crystallization, and also derived from a rhombic prism. The reflected tints are brownish-olive, not unlike dead leaves or brown beech-leaves. These crystals are more doubly absorbent than either the Quinidin or Cinchonine salt, but less powerfully optical as tourmalines than the Quinine or Cinchonine compounds. When polarized, they transmit a sienna-brown body-colour if moderately thick, and thicker plates are bistre-brown; but when sufficiently thick they are wholly impervious to plane polarized light."

† 'Elements of Materia Medica,' vol. ii. pt. 2. pp. 1632-1634.

I have mentioned, under the head *Cinchona nitida*, that I had received from Mr. Pritchett specimens of the three principal varieties of Huanuco bark, deprived of their periderm, and in the state in which they were attempted to be introduced as "Peruvian Calisaya." The *Cascarilla provinciana* is described under the head *Cinchona micrantha*, to which origin I was then disposed to refer all the three sorts so designated; and even since receiving the authenticated specimens above mentioned, I do not find it easy to point out any very characteristic difference in the appearance, except that the *provinciana* is much thinner and more flimsy in its structure, and in the denuded state, as well as in the ordinary quills, curls more in upon itself in drying. The *Cascarilla lustrosa* partakes of a deeper, more rusty red colour, and appears to correspond with a specimen given me by Martius, of *China rubiginosa*, which he had from the hands of Van Bergen. The chemical examination confirms this identification. It is also evidently the "*Quinquina Huanuco* plat, sans épiderme," of plate iv. of Delondre's 'Quinologie,' at page 24 of which work it is well described as follows:—"This bark is gathered in the forests of Huanuco, to the north of Lima, and reaches the port of Callao in serons of 70 to 75 kilogrammes. No species resembles more the barks of Bolivia; and during a considerable period, those who gathered it endeavoured to sell it as true Calisaya. It is, without doubt, this species which Ruiz and Pavon classed under the name of *C. nitida*, and to which they attributed a great superiority. The surface is of a tawny yellow, uniform, with longitudinal furrows, less distinct than those of the Calisaya. The texture of the internal surface is not so close as those of the latter bark. The transverse fracture is of a redder shade ('d'un jaune plus rouge'); the fibres are short, but not easily detached. When chewed, the bitterness is promptly developed; the taste is slightly piquant, without astringency; the thickness of the bark is from 6 to 10 millimètres. This bark, notwithstanding its beautiful appearance, produces only 6 grammes of Sulphate of Quinine, and 12 grammes of Sulphate of Cinchonine per kilogramme." My own examination is given under the head *C. nitida*.

The third sort, the *Cascarilla Pata de Gallinazo*, is the "*Quinquina jaune pâle Huanuco*" of plate iv. of the same author, where both this and the preceding species are well figured. M. Delondre "received some serons of this bark during his stay at Valparaiso, and obtained from it 6 grammes of Sulphate of Quinine, and 10 grammes of Sulphate of Cinchonine per kilogramme. He preserved, both with this and the previous sort, the ticket which had been attached at the time of its collection: and which he gives, apparently in connection with the quill of the same bark, as *Cascarilla encañutada con onbes de las ramas, nombrado Pata de Gallinazo, que antiguamente fué muy apetecida*; that is to say,—Quill bark with its coats, proceeding from the branches, called Pata de Gallinazo, which was formerly the most esteemed. The thickness of this bark is from 4 to 10 millimètres. The external surface is pale-yellow, with some projecting crests and some longitudinal furrows not very distinct: the internal surface is still more pale. The texture is uniform and close; the fracture is with short fibres. The bitterness is speedily developed; a little styptic, with a slightly aromatic taste."

I am unable to account for the circumstance of Quinine being found by M. Delondre in this bark, unless, indeed, the Sulphate of Cinchonidin passed through his hands as Sulphate of Quinine, which might easily happen to be the case; but the entire disappearance of these barks from commerce tends to show that they were considered unfit for the extraction of Quinine. It must be remarked,

nevertheless, that I have myself found Quinine in samples of fine Grey Bark of commerce, apparently proceeding from this source.

It must be understood that the term *Pata de Gallinazo*, being merely founded on some supposed resemblance in the outer coat to the claw of the black vulture, is not to be relied upon as identifying barks of other districts with this. M. Riofrio pointed out to me other quite distinct barks, called by the above name at Loja and other places. This circumstance, and the similar usage of Pavon, has led me to view with a more critical eye a specimen of a flowering branch in the Museum at Kew, from Pavon's herbarium, with a ticket, "C. Pata de Gallinazo, F. P. 588, L. 719, Loja, 805." The flowers are not fully developed; and although I think the specimen belongs to the present species, I have not (in the uncertainty) availed myself at all of this, Mr. Fitch's drawing being made entirely from Mr. Pritchett's specimens, which do not include the flowers. The above specimen, if correct, would show that this species is much nearer to the *C. nitida* than to the *C. micrantha*, with which it is confounded by Poeppig. Neither is it the *C. scrobiculata*, as such is represented by a specimen given me by Dr. Weddell, although the scrobicules are most conspicuous in the *Cinchona Peruviana*. I am not sure, however, that the scrobicules, or glands, as Pavon calls them, in some species, are to be viewed as identical in all cases. Those of the *C. Uritusinga* (the only living plant I can examine by the microscope) do not correspond to the description given in the 'Plantes Equinoctiales' of those of the *C. scrobiculata*. Dr. Weddell seems to be of the same opinion, since he says, under the head of *C. scrobiculata*, "Dans le *C. micrantha* également ce ne sont pas de véritables scrobicules que l'on observe dans l'aisselle des nervures, mais de simples bouquets de poils." The entire dissimilarity of the bark likewise forbids us to confound these species.

CHINCHONA VIOLACEA.

CHINCHONA VIOLACEA, foliis oppositis, petiolatis, oblongis, integerrimis, glabris, nitidis, coriaceis; pedunculis paniculatis; floribus violaceis.

Arbor 2-orgyalis, comâ satis frondosâ ramosâque. *Truncus* solitarius, erectus, teres, cortice satis crasso, rimaceo, rimis transversalibus longitudinalibusque, colore fusco-ferrugineo, maculis nonnullis albicantibus; sapore satis amaro, acidulo; in febribus tertianis usurpari potest. *Rami* erecti, teretes, apice parum compressi, cortice parum albicante; *ramuli* virescentes. *Folia* opposita, petiolata, oblonga, integerrima, glabra, nitida, coriacea, marginibus revolutis, obtuse acuminata, nervosa, parum venosa; nervo centrali crassiore prominente sanguineo. *Glandulæ* solitariae, subtus concavae, rotundatae, minimae, circum villis albicantibus clausae, subtus convexae, prominentes, ad axillas seu nervorum ortum insertae. Folia ad eorum decidentiam colorem sanguineum contrahunt. *Petiolî* breves, teretes, superius parum compressi, sanguinei coloris. *Stipulae* duae, oppositae, erectae, supra-axillares, oblongae, integerrimae, subconnatae, obtusae, marginibus revolutis, glabrae, nitidae, nervo centrali prominente, deciduae. *Pedunculi communes* axillares terminalesque, foliosi, subtetrangulares, glabri, striati, paniculati; foliolis floralibus parvis, ovatis, integerrimis, oppositis, breviter petiolatis, glabris, marginibus revolutis, acuminatis; *partialcs* bracteolis duabus oppositis subulatis ad basim inserti. *Pedicelli* teretes, breves; bracteolis solitariis, subulatis minimis, ad basim et in medio insertis. *Calyx* germenque violacea. *Flores* nonnulli sessiles. *Corolla* dilute violacea; laciniis retroflexis, supra villosa-tomentosis, villis albicantibus. *Antheræ* fauce exsertae, lineares, luteae. *Capsula* oblonga, glabra, calyce magno coronata, sulcis duobus oppositis bilocularis, bivalvis, valvulis basi dehiscentibus.—*Habitat* in collibus proxime vicum de los Azogues appellatum in Quito. *Floret* Junio, Julio, et Augusto. *Vulgo*, *Cascarillo con hojas angostas*.—*Pavon*, *Nueva Quin. sub sp.* 32.

This tree, or rather shrub, appears, from the description, to bear a very close analogy to the *Cinchona crispa* of Tafalla, and as far as I can judge from the sketch drawn by Mr. Fitch from a specimen at Madrid, it would be difficult to point out any specific distinction. At the same time I am not inclined to suppose that a perfect identity exists between two plants marked as distinct by the collectors of bark. This point must therefore be left for the consideration of future botanists.

I am not aware that any authentic specimen exists of the bark. The *Cascarilla negra de Azogues de Loja* is a Loja bark, in twisted pieces, covered with crustaceous and other lichens, but it is only conjecturally the bark of this species.

CHINCHONA TARONTARON.

CHINCHONA TARONTARON, foliis oppositis, petiolatis, oblongo-obovatis, integerrimis, acuminatis, subundulatis, marginibus retroflexis, nervosis.

Arbor 6-7-orgyalis. *Truncus* erectus, teres, solitarius, comâ ramosâ. *Cortex* fuscus, maculis nonnullis albicantibus, rimis transversalibus. *Rami* oppositi, teretes; teneri tetragonales. *Folia* opposita, petiolata, oblongo-obovata, integerrima, acuminata, subundulata, marginibus retroflexis, glabra, subtus nervosa, nervis oppositis alternisque, extus nitidiora; superiora lanceolata, angusta. *Petioles* supra sulcati, subtus teretes, basi incrassati. *Stipulae* oppositæ, interfoliaceæ, supra-axillares, spathulatæ, glabræ, deciduæ. *Panicula* axillaris, pauciflora, terminalisque. *Pedunculi* uni-bi-triflori, bracteolis oppositis, sessilibus, ovatis, concavis acuminatis, patentibus; *pedicelli* bracteolis ad basim solitariis, persistentibus. *Calyx* purpureo-viridis. *Corolla* dilute purpurea, marginibus revolutis, intus pubescens. *Stamina* filamenta basi villosissima. *Antheræ* didymæ. *Capsula* oblongo-cylindrica, bilocularis, bivalvis, a basi ad apicem dehiscens. *Semina* sublunulata, subrotunda, utraque extremitate alâ membranaceâ subulatâ cincta, apice majori, fulvescentia. *Receptaculum* lineare, compressum, torulosum.—*Habitat* in montibus prope Puyaya vicum, ditionis Jaen de Bracamoros Regni Quitensi, circumcirca Marañon fluvium. *Floret* Junio et Julio. *Vernacule*, *Tarontaron*.

The bark of this species consists of crisp, dry pieces, not dissimilar from the product of the *Chinchona rosea* of Pavon (*Lasionema roseum*), but the plant does not appear to be the same. It is of no importance in commerce.

CHINCHONA OBTUSIFOLIA.

CHINCHONA OBTUSIFOLIA, foliis oppositis, petiolatis, ovatis lanceolatisque, oblongis, integerrimis, obtusis, marginibus reflexis.

Arbor $1\frac{1}{2}$ -orgyalis. *Lignum* compactum, luteo colore accensum. *Truncus* erectus, solitarius, brachii crassitudine, cortice aspero, fusco, maculis albicantibus, rimis transversalibus parum profundis vestitus. *Coma* ramosissima. *Cortex* ramorum nigricans, recenter incisus sapore valde amaro, nauseabundo. *Rami* obtuse tetragoni, lineati. *Folia* opposita, petiolata, ovata, lanceolata oblongaque, integerrima, obtusa, marginibus reflexis, carnosæ, venosa, nervosa, utrinque nitida, glabra, obscure viridia: folia inferiora et regenerationis majora. *Petioles* semipollicares, subteretes, superius compressi, coccinei. *Stipulae* interfoliaceae, oppositae, supra-axillares, cauli appressae, ovato-oblongae, obtusae, carnosae, marginibus revolutis, deciduae. *Panicula* ramoso-brachiata. *Pedunculi communes* multiflori, subcorymbosi, oppositi, bracteolis subulatis sparsis persistentibus suffulti. *Pedicelli* bracteolis ejusdem subulatis sparsis persistentibus in medio et ad eorum basin suffulti. *Calyx* campanulatus, persistens, extus rosaceus. *Corolla* coccinea, marginibus revolutis, villosis, villis albicantibus. *Capsula* oblonga, striata, a basi ad apicem hians.—*Habitat* in colle Macos dicto, ditone Vilcobamba, Lojá Provinciâ. *Floret* Maio, Junio, et Julio. *Vulgo*, *Cascarilla crespilla negra mala*. *Vires et Usus*: Cortex amarissimus quamvis nauseabundus; in usu non est.—*Pavon*, *Nueva Quin. sub sp. 1.*

I cannot find that any specimen exists of this plant, and even the bark is but poorly represented in the collection of Pavon in the British Museum. A section of a branch there exists which is to be attributed to this sort, and probably indicates an inferior quality of Loja bark, which is occasionally imported, possessing rather an attractive appearance, but distinguished by a peculiarly nauseous taste, which is probably due to the presence of much kinovic acid.

CHINCHONA VIRIDIFLORA.

CHINCHONA VIRIDIFLORA, foliis oppositis, petiolatis, obovatis, undulatis, acuminatis, pedunculis paniculato-racemosis. *Arbor* 6-orgyalis, erectus, ramosus, comâ frondosâ; cortice albicante cinereo, aspero, intus dilute rubro, sapore parum amaro. *Rami* teretes, teneri tetragoni obtusi. *Folia* opposita, petiolata, obovata, undulata, integerrima, acumine obtuso, marginibus revolutis, nervosa, venosa, venis reticulatis, glabra, nitida, coriacea, ad nervorum axillas piloso-tomentosa. *Petiolî* pubescentes, subteretes, basi incrassati. *Stipulæ* duæ, oppositæ, interfoliaceæ, ovales, undulatæ, erectæ, cauli appressæ, acutæ, integerrimæ, nervo centrali prominente, deciduæ. *Pedunculi communes* axillares, paniculato-racemosi, coarctati, bracteolis duabus oppositis, lanceolato-subulatis, concavis, persistentibus pedunculorum communium partialiumque basim. *Pedicelli* brevissimi, bracteolâ minimâ ovatâ persistente ad basim stipati. *Flores* nonnulli sessiles. *Corolla* parva, viridis, laciniis intus tomentoso-villosis, villis virescentibus. *Capsula* lineari-oblonga, basi apiceque hians, bilocularis, bivalvis.—*Habitat* in altis montibus, Chinchao vico, Chattana et Piñapata, antiqua via vico Cuchero. *Floret* Junio et Julio. *Vulgo*, *Cascarilla Cucharilla*.

The bark of this species is found in the collection of Pavon, and is also to be traced occasionally in importations of Loja bark. It does not appear to have any claim to be considered as of any medicinal value.

CHINCHONA HIRSUTA.

CHINCHONA HIRSUTA, foliis oppositis, petiolatis, ovalibus, marginibus reflexis, crassis, terminalibus subcordatis; floribus corymbosis.—*Cascarillo delgado*, Ruiz, *Quinologia*, art. 3, p. 60. *Sp. Pl. Fl. Per. et Chil.* vol. ii. p. 51, ic. 92. *Arbor* 5-ulnaris, tenuis. *Truncus* solitarius, sæpe plures, crassi, teretes, atri. *Cortex* niger, ex fusco et cinereo colore variegatus, scaber; intus fulvus; amarissimus, acidulus, non ingratus. *Rami* erectes, teretes; juniores obtuse quadrangulares, quadrisulcati, pubescentes, foliosi, post hirsutæ ferrugineæ delapsum atri. *Folia* opposita, approximata, petiolata, ovalia, crassa, subtus valde pubescentia, supra nitida, venosa, venis approximatis; marginibus parum reflexis, integerrima, patentiuscula, plana, terminalia et juniora, plerumque fere cordata, nonnulla oblonga. *Petioles* purpurei, breves, pubescentes, supra leviter canaliculati. *Stipulae* interfoliaceæ, oppositæ, supra-axillares, basi coadunatæ, ovatæ, oblongæque, obtusæ, marginibus retroflexis, interius rubicundiores, deciduæ. *Pedunculi* terminales, compositi, brachiati, tetragoni, quadrisulci, multiflori. *Flores* corymboso-umbellati, breviter pedicellati. *Pedicelli* tetragoni, bracteolâ subulatâ deciduâ suffulti. *Calyx* purpureus, denticulis subulatis longiusculis. *Corolla* purpurascens, extus tomentosa. *Limbus* hirsutissimus, villis albis. *Antheræ* lineares, basi bifidæ. *Capsula* oblonga, magna, pollicaris, profunde decemstriata, obscure purpurea, post exsiccationem atra, a basi ad apicem dehiscens in duas valvulas cymbæformes, apice coalitas; nonnullæ ab apice dehiscunt. *Semina* fulva, membranâ scariosâ helvolâ latâ cineta.—*Habitat* in Andium montibus nemorosis, altis et frigidis locis versus Pillao et Acomayo. *Floret* a Maio ad Octobrem. *Vernacule*, *Cascarilla fina delgada*. *Vires et usus*: hæc species a mercatoribus eodem fere pretio æstimatur ac *Chinchona nitida*. Nos equidem efficacitate hanc illam æquare seu etiam antecellere existimamus. In medecina magno usu fit. *Obs.* Anno 1787 hanc speciem in Pillao locis altis descripsimus.—*Pavon*, *Nueva Quin.* sub sp. 11.

Notwithstanding the commendations bestowed by Pavon on this bark, it seems to have very nearly disappeared from commerce. As it is found in my collection from Madrid, it presents the appearance of an inferior Loja bark, of light specific gravity. It produces, however, an abundant crimson sublimate by heat, and may therefore be more productive of alkaloids than its general character, and long, coarsely-formed capsules, opening at times from the apex towards the base, would lead us to expect.

CHINCHONA SUBCORDATA.

CHINCHONA SUBCORDATA, foliis oppositis, petiolatis, subcordato-ovatis subrotundisque, acuminatis, undulatis; pedunculis axillaribus terminalibusque.

Arbor 4–5-orgyalis. *Truncus* solitarius, erectus, teres; comâ frondosâ, ramosâ. *Cortex* cinereus, satis crassus, scaberimus, fungosus, cinnamomi colore, transversim et longitudinaliter rimaceus, maculis fuscis adpersus. *Ramorum* cortex crassus, asper, satis rimaceus. Cortex teneriorum ramorum levis, extus fusco-ferrugineo colore, intus rubro-sanguineus; sapore amaro, acidulo, non ingrato: virtute febrifugâ pollet; non est in usu. *Rami* tetragoni, obtusi. *Folia* opposita, petiolata, cordato-ovata, obtuse acuminata, nonnulla subrotunda; undulata, integerrima, nonnulla basi decurrentia, extus glabra; *tenera* parum villosa, præcipue per nervos et venas, dilute viridia, subtus magis villosa, per venas et nervos, lævia, parum nitida, per petiolum et nervum centrale purpureo colore, nervosa, venosa, venis reticulatis. *Petoli* teretes, basi crassiores, purpurei, superius canaliculati. *Stipulae* oppositæ, interfoliaceæ, supra-axillares, sessiles, cauli appressæ, virides, deciduæ. *Pedunculi communes* axillares terminalesque, paniculati, tetragoni, pubescentes. *Flores* pedicellati, purpurei, bracteolis lanceolato-subulatis caducis ad basin suffulti, et ad medium insertis. *Pedicelli* breves, bracteolis subrotundis, glandulæformibus, persistentibus, acumine subulato, deciduo, ad basin et ad medium inserti. *Corolla* fundo magis violacea, pubescens; laciniis supra villosis, villis albicantibus. *Antheræ* oblongo-lineares, per medium filamentis insertæ, fauce corollæ inclusæ. *Germen* obovatum, pubescens. *Capsula* oblongo-linearis, calyce coronata, parum compressa, sulcis duobus oppositis, leviter angulata, parum curvata, bivalvis, valvulis basi dehiscentibus. *Semina* ceteris speciebus consimilia.—*Observ.* Nonnulla germina monstrosa fiunt, ob insectorum punctiorem devenientia.—*Habitat* in collibus Anganuma, Vilcabamba tractus, Loxa provinciâ. *Floret* a Julio ad Octobrem. *Vernacule* Pata de Gallinazo.—*Pavon*, *Nueva Quin.* sub *sp.* 15.

The bark produced by this species, and found in Pavon's collection, was determined by Dr. Pereira and myself as identical with the "Ash Bark," which is noticed and described in his 'Materia Medica.' It is now found only occasionally and by accident mixed with other barks in commerce.

The tree itself must have considerable analogy with the *C. cordifolia* of Mutis, if I may judge from a tracing which M. Guibourt was good enough to have made for me at Paris of the specimen.

The bark, under the microscope, presents several peculiarities of structure, which will be found noticed in connection with the drawing of a section.

Chemically considered, it contains about two parts in a hundred of alkaloids, chiefly Cinchonine and the allied alkaloids.

CHINCHONA SUBEROSA.

CHINCHONA SUBEROSA, foliis oppositis, petiolatis, oblongis, acuminatis, subtus pubescentibus; cortice suberoso; floribus paniculatis.

Arbor 3-4-orgyalis. *Truncus* solitarius, erectus, teres; comâ frondosâ, ramosâ; cortice crasso suberoso, maculis nonnullis fuscis cinereis, colore intus extusque ferrugineo, rimis longitudinalibus transversalibusque. *Rami* læves, tetragoni, striati, pubescentes, pubescentia albicante. *Folia* opposita, petiolata, oblonga, acuminata, acumine obtuso, integerrima, parum undulata, supra nitida, subtus pubescentia, nervosa, venosa, venis reticulatis marginibus retroflexis, nonnulla rotundata; foliola superiora minora, lanceolata. *Glandulæ* minimæ, rotundatæ, subtus concavæ, circum villis albicantibus ad nervorum ortum insertis, supra prominentibus. *Petioles* teretes, superne compressi, basi incrassati, rubro-sanguinei uti nervi centrales foliorum. *Stipulæ* interfoliaceæ, supra-axillares, oblongæ, integerrimæ, cauli appressæ, tenues, erectæ, apice rotundatæ, deciduæ, nervo centrali prominente. *Pedunculi communes* axillares terminalesque, foliosi, pubescentes, tetragoni; *partiales* dichotomi, bracteolati; bracteolis duabus, oppositis, petiolatis, integris, parvis, lanceolatis, patentibus. *Pedicelli* bracteolis solitariis, subulatis longis, ad basim et in medio insertis, pubescentes. *Calyx* rubicundus, pubescens. *Corolla* rubra, pubescens; laciniis patentibus, superne villosa-tomentosis, villis albicantibus; tubo interne prope filamenta pubescente. *Antheræ* supra faucem prominentes. *Capsula* pyramidalis oblongaque, rubra, bilocularis, bivalvis, valvulis basi dehiscentibus. *Semina* oblonga, ala membranacea, crenata, basi apiceque bifida. *Receptaculum* lineare.—*Habitat* in collibus Anganuma, et Macos ditene Vilcabamba, locis parum frigidis, in Loxa provinciâ. *Floret* Junio, Julio, et Augusto. *Vernacule*, *Cascarilla blanca* *Pata de Gallinazo*, y á la variedad *Cascarilla crespilla de Jaen*.—*Pavon*, *Nueva Quin.* sub sp. 35.

There is one specimen of this at the Royal Museum at Madrid, consisting simply of a branch with immature fruits and no flowers,—not sufficient therefore for representation in a plate, but disclosing a *facies* very different from that of any other species. The bark also possesses a marked character of its own, and occurs not unfrequently in parcels of the “Grey Bark” of commerce, and also as a spurious admixture in some importations of Calisaya quills from Carabaya. It has been noticed in this connection, and very well described by the late Dr. Reichel, who possessed specimens of the bark as collected by Pavon. He says* that he found the barks of *Cinchona suberosa*, R. et P., mixed with Calisaya about in the following proportion, viz., one-sixth part of *C. suberosa*, one-twentieth of young quill bark of *C. Calisaya*, and the rest barks of the *C. nitida*. This agrees with the results of my own observation, with this exception, that I consider the presumed barks of the *C. nitida* to have their origin in the then undescribed *C. heterophylla*. Reichel adds, that these barks of *C. suberosa* agree with the specimens of Ruiz and Pavon; and although figured by Bergen amongst the dark Jaen or Pseudo-Loja barks, are distinguished by the following characteristics:—1st, a much lighter specific gravity; 2nd, a colour everywhere shading off to green-brown; 3rd, fewer cross-cracks than the last, and these also so slightly impressed as to be scarcely perceptible on cursory inspection; 4th, the taste is less strongly bitter than that of the dark Jaen bark, but is about equal in medicinal effect. I have said, in my ‘Examination of Pavon’s collection’ (p. 29), that this sort is remarkable for the abundance of cork which it produces, so that some pieces almost resemble the produce of the genuine cork-tree, only that it gives way in cross-cracks as well as laterally.

* Reichel über China-rinden und deren Chemische Bestandtheile (p. 49). Leipzig, 1856.

CHINCHONA LUCUMÆFOLIA.

CHINCHONA LUCUMÆFOLIA, foliis oppositis, petiolatis, lanceolatis oblongisque, obtusis stipulis oppositis, oblongo-obovatis, deciduis.

Arbor 3-4-orgyalis, ramosa. *Lignum* compactum, luteo colore, comâ ramosâ. *Truncus* solitarius, teres; rectus diameter semiulnaris; *cortex exterior* tenuis, albicans, fungosus; rimis longitudinalibus, profundis, nonnullis transversalibus profundisque; *cortex interior* compactus, crassior, cinnamomi coloris, lævis; cortex ramorum valde amarus dum viridis, lævis, fibrosus. *Rami* teneri, teretes, glabri, purpurei. *Folia* opposita, petiolata, lanceolata oblongaque, subdecurrentia, obtusa, integerrima, glabra, nitida, nervosa venosaque nervis alternis, crassa, coriacea, marginibus revolutis. *Petioles* purpurei, subtus teretes, supra compressi, striati, basi crassiores. *Stipulae* oppositæ, interfoliaceæ, supra-axillares, oblongo-obovatae, sessiles, acutæ, deciduæ. *Panicula* coarctata. *Pedunculi communes* axillares terminalesque, tetragonales, oppositi, multiflori; *partiales* oppositi, bi-triflori, dichotomi; bracteolis oppositis, subulatis, persistentibus. *Pedicelli* sparsi, bracteolis minimis persistentibus ad eorum basim suffulti. *Corolla* extus obscure purpurea, intus rosacea; laciniis revolutis, intus tomentosis villis albicantibus. *Capsula* ovalis, glabra, parum compressa, duobus sulcis longitudinalibus oppositis, nonnullæ capsulae ventricosæ, bilocularis, bivalvis, a basi ad apicem dehiscens.—*Habitat* in collibus Macos, Angamuna et Yangana, Vilcabamba ditone, Loja Provinciana. *Floret* Maio, Junio, et Julio. *Vulgo*, *Cascarilla con hojas de Lugma*. *Vires et Usus*: Cortex amarus, non ingratus; pro febrifugo mediocri reputari debet; non est in usu.—*Pavon*, *Nueva Quin. sub sp. 2.*

Pavon marks a variety which he calls 2^a *Especie*, which grows in the *Cerros* of Ama and Boqueron, in the jurisdiction of Vilcabamba, in the province of Loja: "This variety differs only in the leaves, which are more obtuse and more abundant in nerves; in the corollas, which are more narrow; and in the calyx, which is larger: moreover, some of the capsules are globose, and others are oval. The barks have the same colour, consistency, and bitterness." I may add that, according to the specimens in Pavon's collection, the bark of this second species is paler, and of brown colour in the substance.

My specimen from Pavon (which is not distinguished as first or second variety) coincides well with one which I received from Don T. Riofrio, under the same designation of *Hoja de Lugma*, together with the leaves of the same species. It thus appears that this sort is familiarly known in Peru under the same designation as in the time of Pavon. It occurs not unfrequently as white large quills amongst samples of Grey Bark, and it also occasionally forms a portion of the importations of "Carthagena" bark. The larger quills (from Cuenca) present a beautiful appearance, through the abundant development of the corky layer, which is peculiarly silvery and lustrous, deeply furrowed with longitudinal clefts, and clothed with many adherent lichens.

Quills similar to those given me by Riofrio have yielded me,—Quinine, 0.68; Cinchonidine, 0.63; and Cinchonine?, 0.31: total, 1.62 per cent. It must therefore be classed amongst the more productive of the class of barks amongst which it comes.

The microscopical examination discloses a peculiar structure, which explains the woody character of the internal bark or liber, and the resinous character of the cellular envelope.

ADDENDA ET CORRIGENDA.

SINCE writing the above, I have had the opportunity of entertaining Don T. F. Riofrio at my house, and am gratified to find that the descriptions I have given of the Barks of Loja, Cuenca, and El Pan agree with the information which, as a native of Loja, and a dealer in these particular Barks, he has received. He looks upon the bark which I have described as that of *C. obtusifolia*, as a sort now brought from Ayabaca, south of Loja, from which place, no doubt, the large importation of 326 chests, from which my specimens were taken, came by way of Payta in 1853. It contained from 2 to 3 per cent. of alkaloids, chiefly the Cinchonidine of Pasteur.

M. Riofrio recognizes my specimen of the bark of *C. lanceolata* as coming at the present time from Cuenca, as likewise the bark of *C. stupea*, as forming the “*estoposa*” sort from El Pan, and the bark of *C. villosa* (the Pseudo-Loja of Bergen), as now obtained at Zaraguro, in the province of Loja. Also a certain “*crepillla*” bark, rather largely imported *viâ* Guayaquil at present, and sold as Crown Bark, is identified by M. Riofrio as proceeding from a Cinchona not unlike the specimens of “*crepillla chica*” or *C. Pahudiana*, which I showed him, from Java. If this should prove correct, and the two sorts be nearly identical, it is possible that the bark from Java may in like manner find ready customers amongst the druggists, and thus reward the pains taken in its cultivation. M. De Vrij writes me word that he has now analysed the bark of a flourishing tree of the *C. Pahudiana*, 16 feet in height and $10\frac{3}{4}$ inches in circumference. From 122 grammes of well-dried bark from the lower part of the trunk he obtained 1.555 grammes of alkaloid, equal to 1.274, or somewhat more than $1\frac{1}{4}$ per cent. After having ascertained that the alkaloid thus obtained did *not* contain Quinidine, he found 0.57 grammes to be soluble in ether. On evaporation he obtained a crystalline residue which contained only a very small quantity of Quinine. M. De Vrij is not yet certain of the nature of the alkaloid which formed the greater portion of the soluble residuum, but regards the total contents of the bark as chiefly Cinchonine, and also an alkaloid soluble in ether, besides a very small quantity of Quinine, forming Herapathite. From the roots of the same tree he obtained 157 grammes of well-dried bark, which yielded 4.425 grammes of alkaloid, containing 2.903 grammes of Quinine, and 1.522 of Cinchonine. Consequently M. De Vrij thinks that the root bark of the *C. Pahudiana* contains 1.849 per cent. of Quinine, and 0.97 per cent. of Cinchonine; but he does not mention whether the Quinine was in such a state as to be capable of crystallization when united with acids. This is not generally the case in root barks, as far as my experience extends; and the presence of Quinine would be of little value in this altered state, in which it is frequently found.

A parcel of thirteen large chests of the *Huamalies* of Bergen and Reichel has just been offered for sale here. I am informed by the broker that it has been thirty years in this country, and can readily credit this information, as it is a sort which no longer comes in commerce, though it once commanded a high price in the markets. I have examined this, and find that it corresponds well with Bergen's plate v.; and the analysis which I have made corresponds sufficiently with that given by that author, as in those days the whole contents might very well pass for Cinchonine. They are, however, more exactly as follows:—Cinchonine, .77; Aricine (with a little Cinchonidine?), .66; total, 1.44: thus marking a poor bark, which probably owed its reputation to the strong bitter imparted especially by the Aricine. This latter ingredient is also confirmatory, by analogy with the bark of *C. pubescens*, of its derivation from the *Cinchona purpurea*, from which, I have no doubt, it is derived, as see the description under the head *C. purpurea*. It is quite soluble in ether, and in separating from this medium presents a resinous appearance, so much like Quinine, that it may easily have been confounded with it; but it gives no green colour with Chlorine and Ammonia, and does not crystallize as a sulphate. This confusion may perhaps explain the large percentage of Quinine stated to be found in Huamalies bark by some chemists, the results of whose experiments are collected by Pereira.*

The reader will please to supply the following omissions. Under the Latin diagnosis of the *C. micrantha* should be inserted the words “Pavon, Nueva Quin. sub sp. 38;” under that of *C. ovata*, “Pavon, Nueva Quin. sub sp. 13;” under that of *C. obovata*, “Pavon, Nueva Quin. sub sp. 22;” and under that of *C. magnifolia*, “Pavon, Nueva Quin. sub sp. 24.”

Mr. Darwin read an exceedingly interesting paper at the meeting of the Linnæan Society on the 21st November, in which he stated the results of observations made on what the Spaniards call the *macho* and *hembra* forms of certain flowers, and deduced from his elaborate observations conclusions as to the practical bearing of this variation in structure on the fruitfulness of the seeds of these plants, which are highly interesting and important. This will be remembered in connection with the remarks on this subject under the head of *C. Chahuarguera*.

The critical reader will detect the old Spanish *x* in some places instead of the modern *j*. This has been in some cases intentionally left uncorrected, in order to facilitate reference to those accustomed to the old spelling of Spanish words.

I have hesitated much whether to substitute *Chinchona* in all cases for the unquestionably erroneous spelling *Cinchona*. The reader will therefore pardon the inconsistency apparent in the use of both.

For *Hualasco*, under the head *C. stupea*, read *Hualaseo*.

* ‘Materia Medica,’ vol. ii. part 2, p. 1636.

Fig: 1.

Cascarilla colorada del Rey.

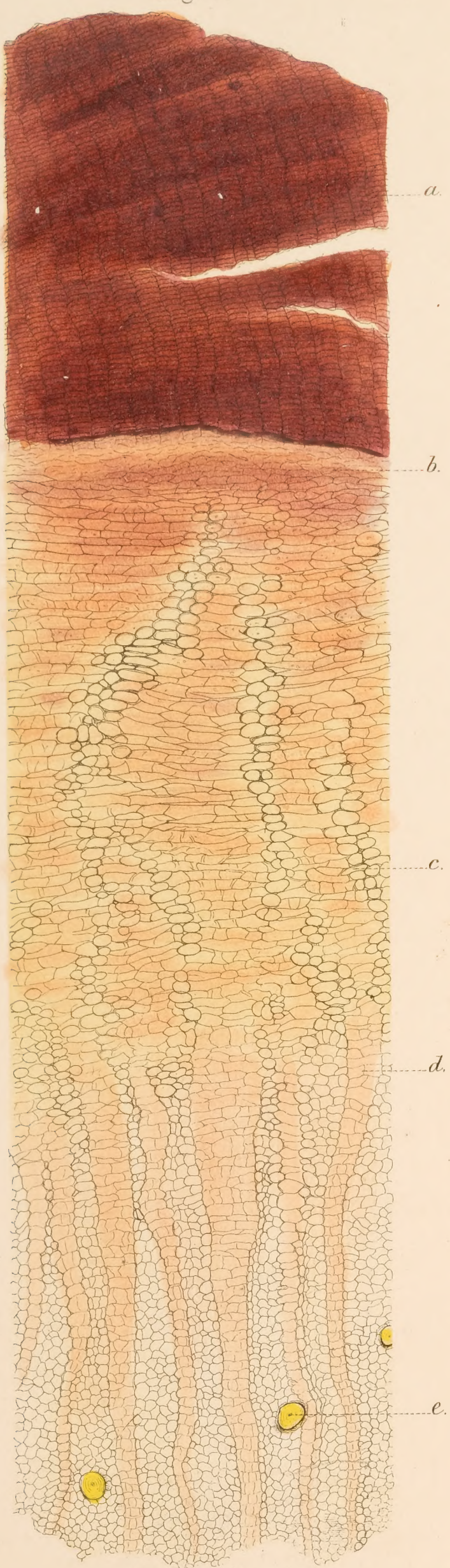


Fig: 2.

C. amarilla del Rey.

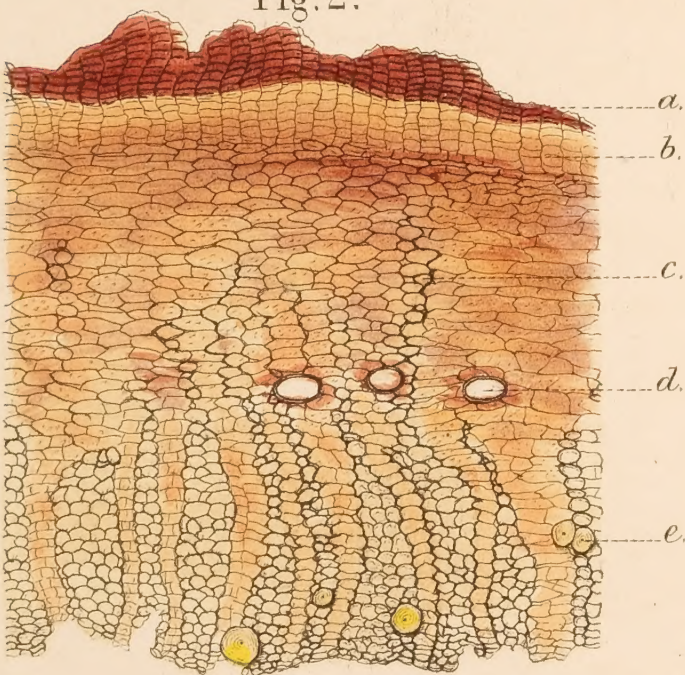


Fig: 3.

Cascarilla Provinciana.



Fig: 4.

Cascarilla Reicheliana.

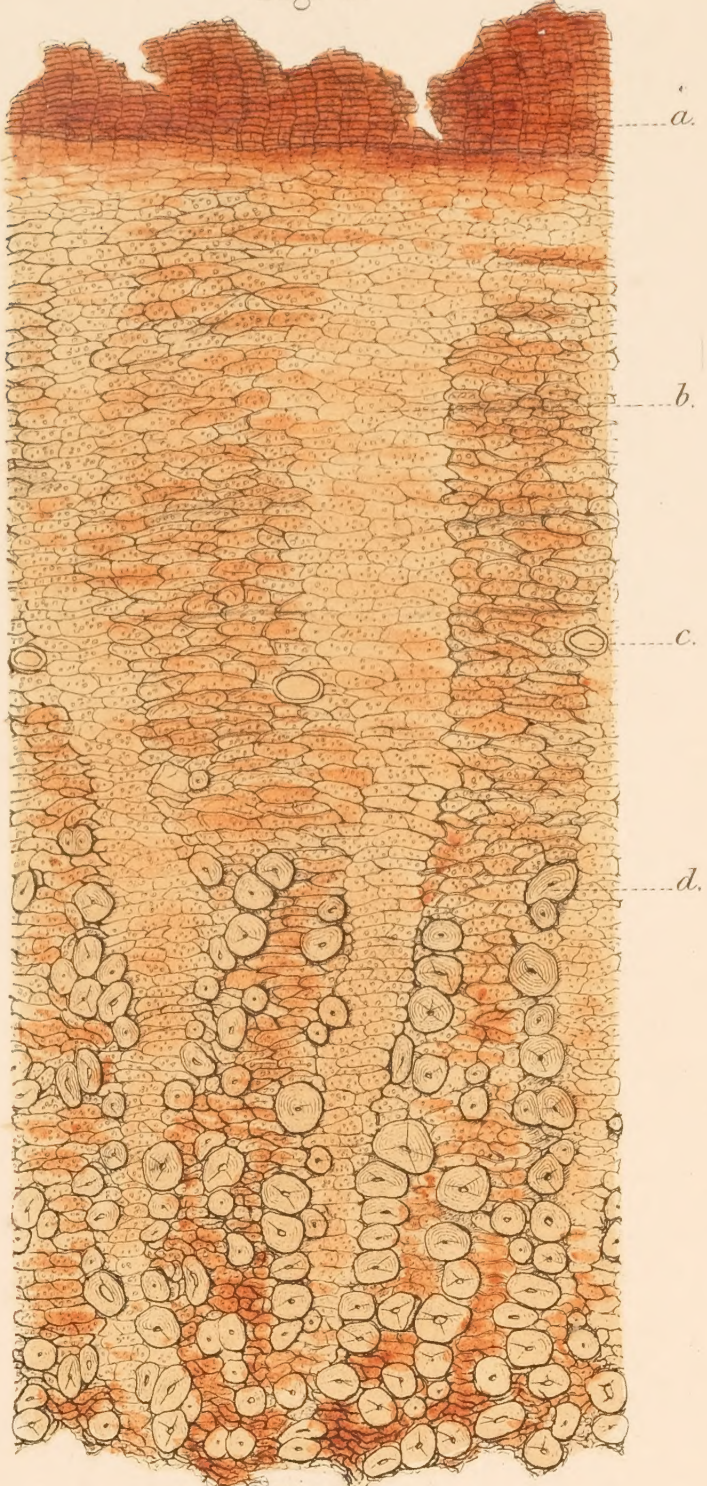


Fig: 5.

Quina cana legilima.

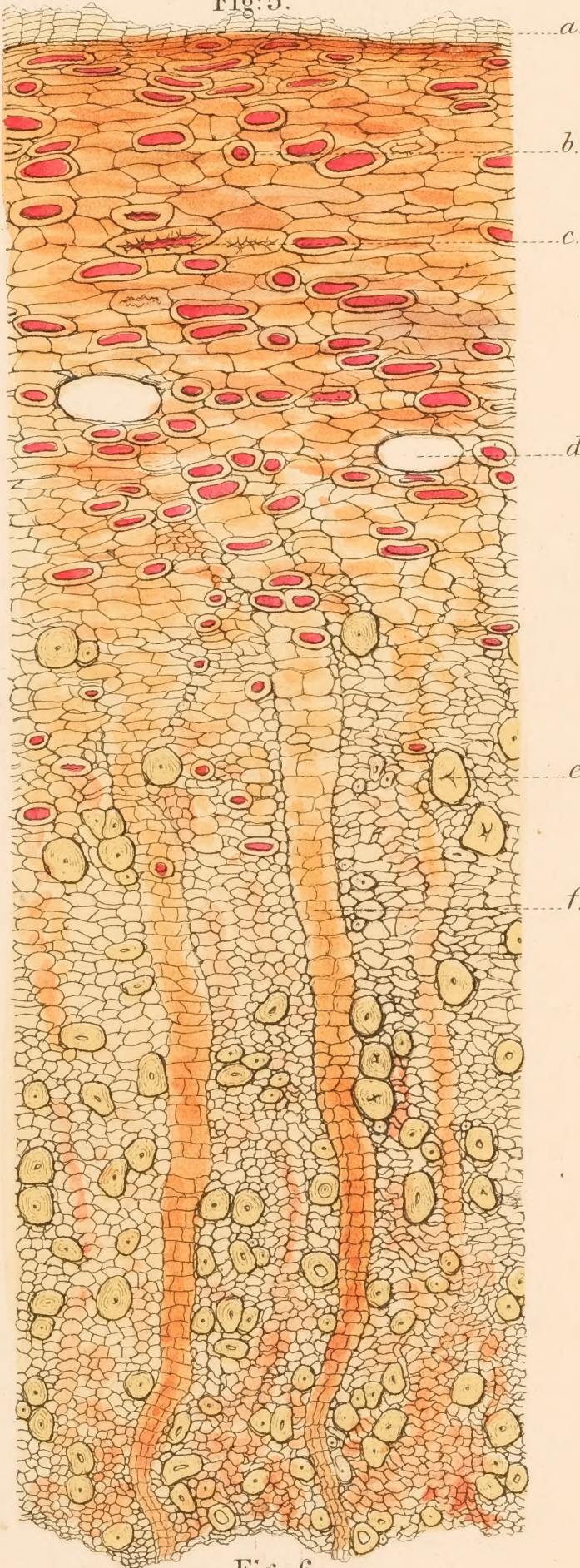


Fig: 6.

Casc: con Hojas redondas.

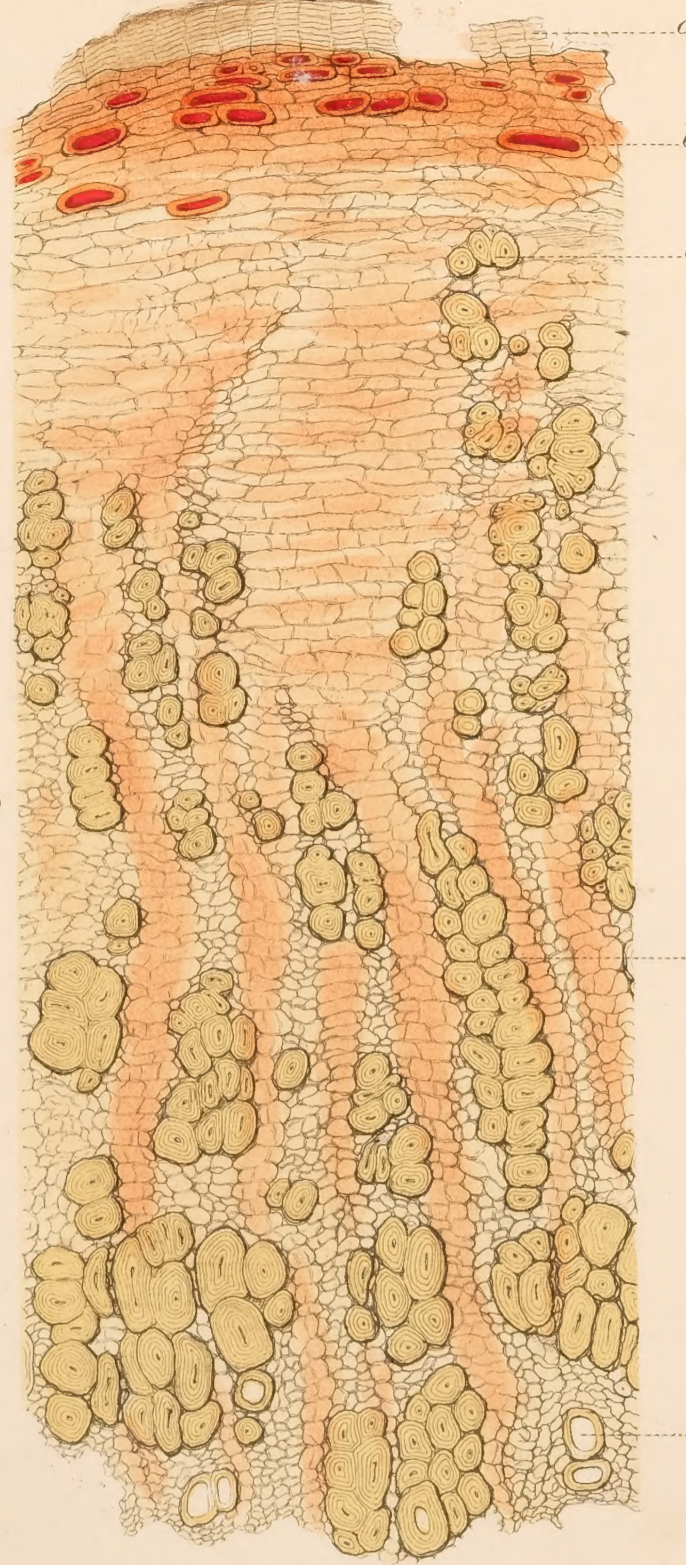


Fig: 7.

Cascarilla Pata de Gallinazo.

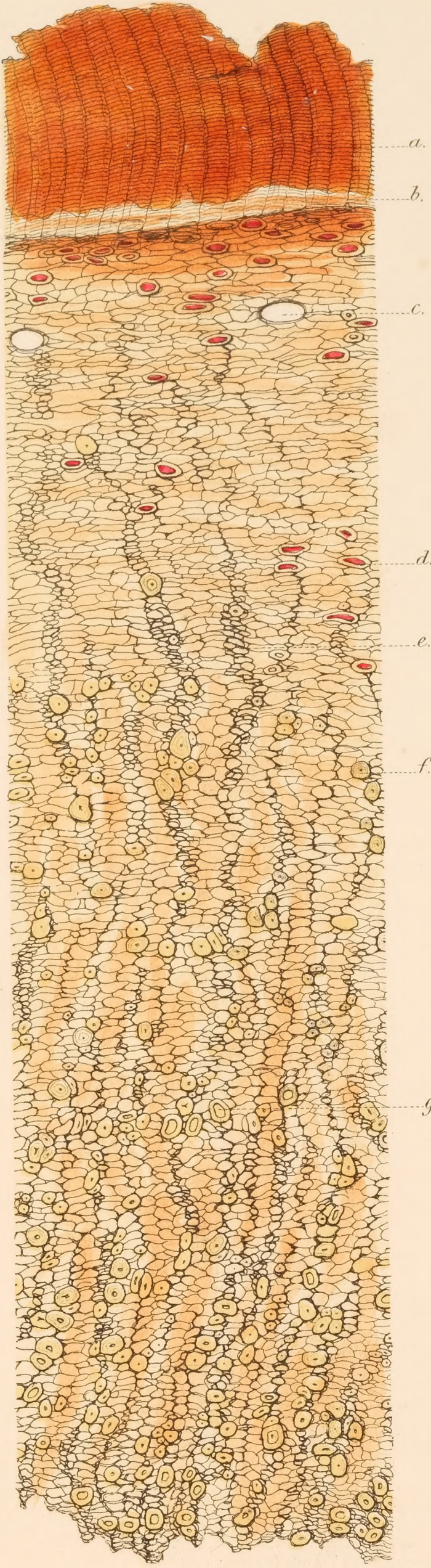


Fig: 8.

Cascarilla con Hojas de Ingua.

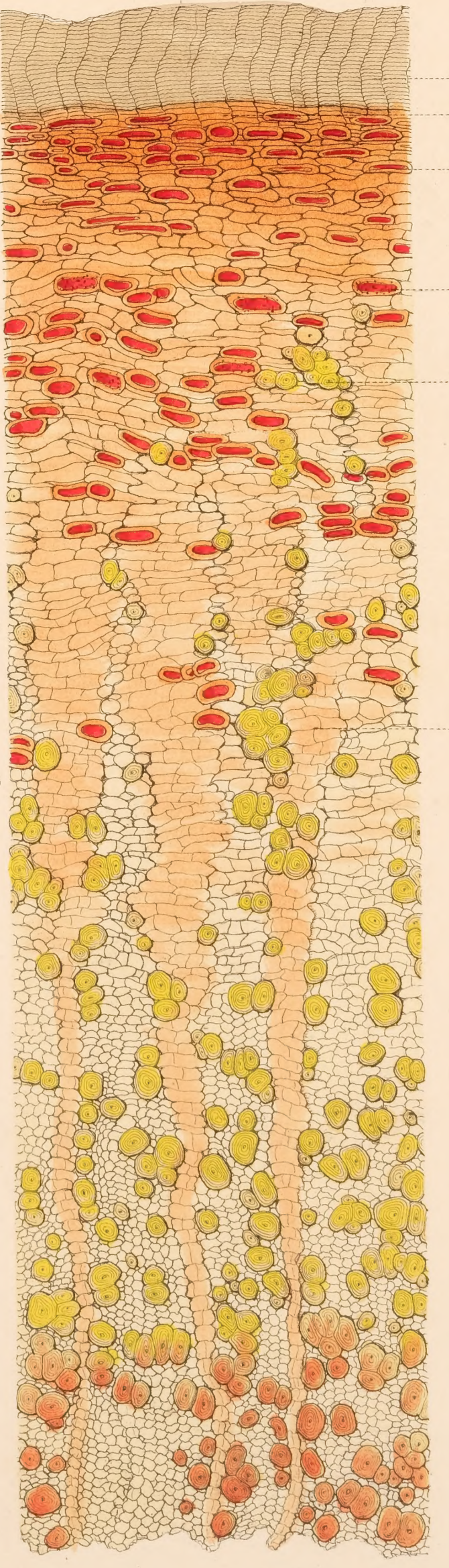


Fig: 9.

Cascarilla amarilla de Yuta.

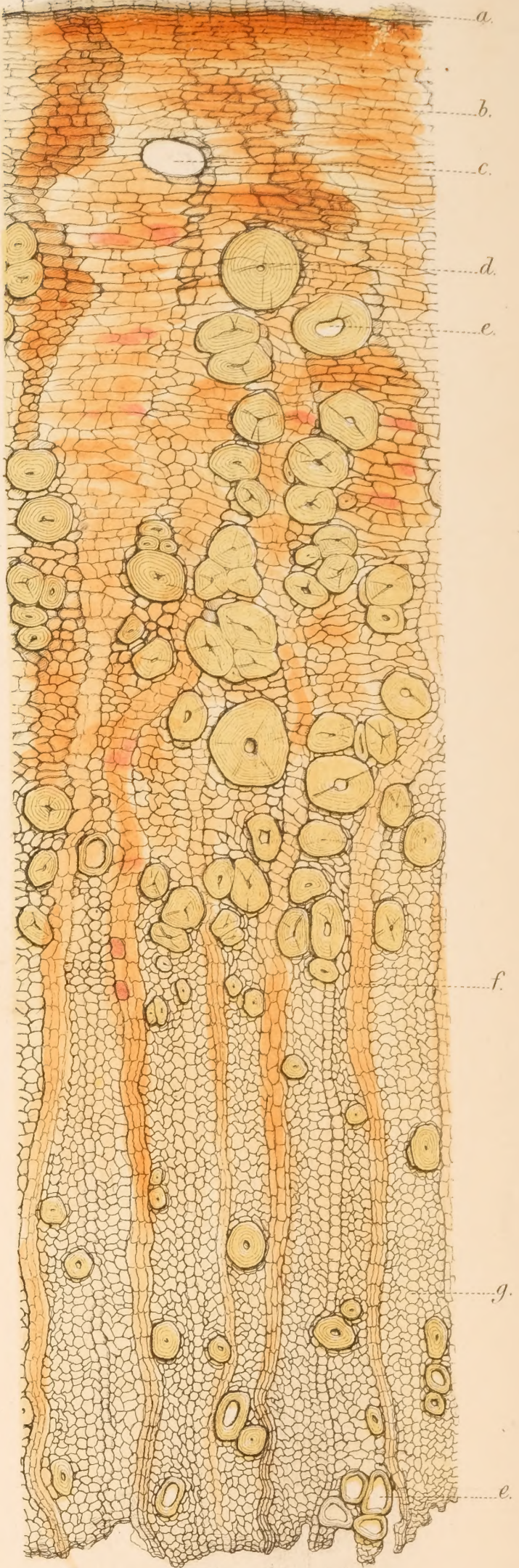


Fig: 10.

Cascarilla amarilla de Chito.



MICROSCOPICAL OBSERVATIONS.

GENERAL STRUCTURE.

IN order to understand better the changes which occur in the course of the development of the bark, I took the stem of a young *Calisaya* which had lived and died in this country, and divided it into sections; one, about eighteen inches from the ground, near to the succulent summit; a second, about thirteen inches, just above a node, from which two branches had proceeded; the third, about five inches, just below the first two branches; the fourth, an inch above the roots; the fifth, just below the sending forth of the largest lateral roots.

In the first section we meet, *first*, observing from without inwards, a very thin epidermal suberous layer; *second*, a wide portion of thick-walled oblong parenchymatous cells; this region of cellular tissue bounded very distinctly by, *third*, numerous laticiferous ducts; *fourth*, a thin zone of liber, crossed by medullary rays, and consisting of smaller polygonal cells with some scattered well-developed liber-fibres interspersed; *fifth*, the region of cambium, not well defined, perhaps owing to the disease which occasioned the death of the plant; *sixth*, wood, as in Weddell,* but with cells more markedly pitted than is evident in his Plate II.; *seventh*, large internal pith; some of the cells near the wood filled with coloured sap, lacunæ at regular intervals, and the pith-cells filled with indistinct formation, as in Weddell's plate.

In the second section the region of cellular tissue is narrower in proportion to the whole width of the stem, and the cells seem more pressed together towards the circumference; the liber has become more developed, and is wider in proportion. No perceptible alteration in the other parts of the section.

In the third section occurs a marked increase in the width and proportionate development of the bark. The region of the cambium is now well marked, but the boundary between the cellular tissue and the liber has become much less distinct, and the laticiferous ducts have almost or altogether disappeared. The lacunæ in the pith no longer form a circle near the periphery, but are irregularly scattered. This section was just below two considerable branches.

In the fourth section the whole structure appears more mature. The external cellular layer is more pressed together, and arranged in concentric layers of cells passing by insensible transition into the smaller-celled structure of the inner liber, into and through which the oblong-celled formation passes, thus forming the medullary rays. Nevertheless, although no sharp line of distinction can any longer be drawn, there must be imagined to exist, at about the distance of one-third from the epidermis to the cambium, a circular line, within which are contained all the scattered liber-fibres, as also the medullary

* 'Histoire des Quinquinas,' pl. i. fig. 26, 27.

rays, and at intervals, as if placed on this imaginary circle, there are now to be seen very small but very distinct laticiferous ducts. The cambium region is distinct; some of the liber-fibres are now larger; the wood has greatly trenched upon the pith, which has here lost all lacunæ, and the cells have become few, but these are large, and strongly pitted.

Much resemblance exists between this section of more mature bark and that of the *amarilla del Rey*, both being also Quinine-producing plants.

In the fifth section, half an inch below the first large side-roots, the structure becomes more confused; the outer bark is thicker, and the strongly-marked medullary rays are seen very evidently conveying the coloured fluids of the bark into the medullary rays of the wood, towards the centre of which they penetrate; thus furnishing a channel for throwing into the ever-active circulation of the plant some of the substances which have been elaborated in the bark, and which may be carried by the ascending circulation to fulfil important purposes in other regions of the plant.

The whole thickness of the stem in the first section is five-twentieths of an inch; in the second, six-twentieths; in the third and fourth, eight-twentieths; in the fifth, twelve-twentieths.

I subsequently examined a plant of *C. Calisaya*, var. *Josephiana*, which I saw beautifully in flower at the Chiswick Gardens in 1854. This died soon afterwards, and came into my hands in a dried state. The results of investigation by the microscope were similar to those above detailed.

My further observations will have reference to the different regions of the bark pointed out in the foregoing examination: 1st, the epidermis or cuticle; 2nd, the cellular tissue; 3rd, the laticiferous vessels; 4th, the zone of liber crossed by (prolonged, or, according to Weddell, *false*) medullary rays; 5th, the cambium; 6th, the wood; 7th, the pith, or heart-wood. It will nevertheless be evident, even from slight inspection of the microscopic sections, that no sharply-drawn line of demarcation separates between the different regions of bark-formation; and indeed the active vital processes which are continually going forwards in the living bark, tend constantly towards the obliteration of some of these distinctions, and especially towards throwing off continually more and more of the bark as cork, this latter formation in some cases eating down (as it were) into the very substance of the bark. In several of the drawings there will be seen portions of the cellular envelope, which appear to be on the verge of undergoing this transformation, either by addition of fresh cells or change of those previously existing. It is probable that the continual formation of new substance in the bark exerts a pressure on the external cells, whilst the active circulation going forwards in the bark is gradually reabsorbing all their contents, and they ultimately are seen, as in (*b*), fig. 1, 2, and 25, as almost empty flat cells arranged in parallel rows, and often deeply fissured and cleft, all vitality having long since departed, and the cork then merely serving the purpose of an external shield, and being entirely destitute of therapeutic powers.

FORMATION OF ALKALOIDS.

The various alkaloids are produced in the bark itself, and that probably by a reaction between the ammonia, which (according to De Vrij) is everywhere contained in the plant, and the cinchotannic acid. The general condition of the alkaloids is that of being more pure and easily separated from adventitious substances in the bark of the branches, somewhat less so in that of the trunk, and of all most impure in that of the roots. Indeed it would seem that the alkaloids, after a state of quasi-combination has been passed through, especially with certain resinous, gummy, and colouring matters, are found in a state no longer susceptible of crystallization, having thus passed into substances really different in nature, although ultimate analysis may fail to detect any difference.

SEAT OF THE ALKALOIDS IN THE BARK.

Authors on Bark, from Ruiz and Pavon down to the present time, are in accord on one point, that it is the astringent principle which predominates in the *canutillos*, or very small-quilled bark. If it were possible to separate the bark of the first section as above, we should probably find in it much cinchotannic acid, some kinovic acid, and perhaps kinate of lime, and very little alkaloid. Indeed we must probably travel down to the fourth section before the Quinine would be found decidedly to preponderate over, and (as I think) at the expense of, the tannin principle of the Cinchona. I have just examined some remarkably small quills of *Cinchona Calisaya*, grown apparently high up the mountain, which gave Quinine, which it was difficult to free from some tannin in a state of quasi-combination. The more matured bark out of the same parcel, gave Quinine more easily purified. It is the ordinary state of things for the percentage of alkaloids to increase with the maturity of the bark. In the quills from the large branches (*canutos*), there is more than in the *canutillos*, and in the bark from the trunk, or *tabla*, the proportion of alkaloid is still further increased; but this again diminishes in quantity and deteriorates in quality when we descend to the bark of the roots of the tree. It is therefore the height of improvidence for the collectors to strip off the bark from the roots, thus securing a worthless product at the expense of any possible future renovation of the tree.

A particular parcel of fine *Calisaya*, examined carefully for comparison, gave me,—from the *Canuto* (marked *CC*), Quinine and a small portion of Cinchonidine, 3.21; Cinchonine, 0.01: total, 3.22. The *Charquesillo* (marked *CC*) gave Quinine and Cinchonidine (as above), 3.41; Cinchonine, 0.03: total, 3.44. The *Tabla* (marked *C*) gave Quinine and Cinchonidine (as above), 3.55; Cinchonine, 0.04: total, 3.59.

Coincident with the gradual formation (or at least accumulation) of alkaloid, the bark itself passes through changes, as we have seen in the *Calisaya* plant, obliterating the marked distinction between cellular tissue and liber, which in the very early stage assimilates the above-mentioned bark to that of *C. ovata*, as represented by Weddell in his tab. ii. fig. 42, diminishing also both the number and the size of the laticiferous vessels, until at length these are wholly absorbed and lost, and the structure of the bark becomes on the trunk of the tree that which is so well described by Weddell, and figured in tab. xxviii. fig. 1, 2 of his 'Histoire,' and the section that of tab. ii. fig. 30.

It becomes therefore an interesting question to decide what is the relation in which the formation of alkaloid stands to the structural change we have noticed. Are these phenomena simply co-existent, or is there some dependence in the way of cause and effect between them? It is certainly true that the observations made by Weddell are, generally speaking, correct as to the mode of fracture which is peculiar to rich Quinine-producing *Calisaya*; and when we find the same type of things extending also to other species, as, for instance, to the bark of *C. lancifolia*, it is scarcely possible to avoid the conclusion, that there must be some dependence as well as connection. Nevertheless, it is obvious that the mere shape and scattering of the liber-fibres cannot in itself produce any definite result. These hard and bony portions cannot be themselves the depositories of the alkaloids, neither do these last accumulate in the same ratio as the liber-fibres, but the contrary.

What, then, is the connection? All observation shows us that the solid and fixed organized tissue which alone in dried barks can be subjected to microscopic investigation, is subordinate in point of real importance to the vital processes, inappreciable to sight, which are continually going forwards in the living plant, and which result in the production of the organized portions. We cannot therefore reason backwards, and represent these latter as the cause of the former, from which they proceed, unless indeed the manner of growth of the plant, inducing, for instance, the production of stronger,

coarser, and more compacted liber-fibres, leads to the formation of these out of protoplasmic material, which might otherwise have conduced to the formation of the alkaloids; the whole resulting in a woody instead of a richly medicinal bark. That such is indeed, *in some way*, the fact, is well known to dealers in these barks, since experience teaches the collectors that the growth of the tree (in warm valleys, for instance,) under circumstances favourable to the production of bark with strong prevalent woody fibre, is unfavourable to the development of the alkaloids; and that, on the other hand, an elevated situation and rather cold atmosphere, tending to the predominance of *parenchyma* (whether as cellular envelope or mingled with the liber) over that of the *prosenchyma* of the liber, assists in the formation of the richest and especially the most Quinine-producing specimens of bark. This is seen not only in the bark of the *C. Calisaya*, but also in that of the *C. lancifolia* and the *C. Pitayensis*, and is so well understood that the price always rises in proportion. Mr. Spruce says:* “From the *cascañillos* I learnt that although the Bark Trees growing nearest the plain were generally much larger, yet their bark was by no means so thick in proportion to their diameter as in trees higher up, which I can well believe; for in cutting down trees in the hot plains, I have often been struck with the thinness of the bark compared to that of trees growing in temperate climes.”

The above observation has reference to the product of trees of the same species grown at different altitudes, and is, I believe, so far universally correct; the Red Bark tree itself, which descends to the lowest elevation, not furnishing an exception, since, according to Mr. Spruce, Señor Cordovez, who had analysed the red bark collected at various altitudes, stated that the greater the height at which the tree grows, the larger is the proportion of alkaloids contained in the bark.† At the same time it must be remembered, that it is impossible to reason correctly from one species to another, and to suppose that an analogous ultimate structure of the bark must necessarily indicate similar richness in alkaloids. If the nature of the species forbids this hope (as in the case of *C. pubescens*, for instance), no elevation of place of growth, nor any preponderance of cellular envelope, will compensate for this inherent deficiency.

If the theory which I have advanced above as to the formation of the alkaloids by a reaction between the cinchotannic acid and the ammonia be correct, it is obvious that it is useless to look for any alkaloid worthy of the search, where this peculiar product of the *Cinchonæ* is either almost or altogether absent. I have mentioned elsewhere my reasons for believing the red colouring matter of the *Ladenbergiæ* to be quite foreign to that of the *Cinchonæ*, and I should trace the extreme poverty of that genus in alkaloids to this cause rather than to the differences in the ultimate structure of the two barks. The same reasoning would hold good concerning all those species of *Cinchona* which are deficient in the power of producing cinchotannic acid.

I regret, therefore, that whilst bearing my testimony to the skill of analysis, as well as beauty of illustration, with which Dr. Weddell has treated this subject,‡ I find myself compelled to differ from the reasoning which he based on comparison of different species of *Cinchonæ*, which had then been very imperfectly studied in a chemical point of view; and more particularly must I dissent from his conclusion, that the cinchonine is specially to be found in the cellular envelope, and the quinine in the liber. The result of analysis tends almost to reverse this decision.

COMPARATIVE VIEW OF THE CELLULAR ENVELOPE AND THE LIBER.

To ascertain the comparative value of the different portions of the bark is a matter of interest,

* Report on the Expedition to procure seeds and plants of the *C. succirubra* or Bark Tree, by R. Spruce, Esq., 1861, p. 27.

† Ibid., p. 33.

‡ Histoire, etc., p. 23.

Fig: 11.

Cascarilla colorada de Huancabamba.

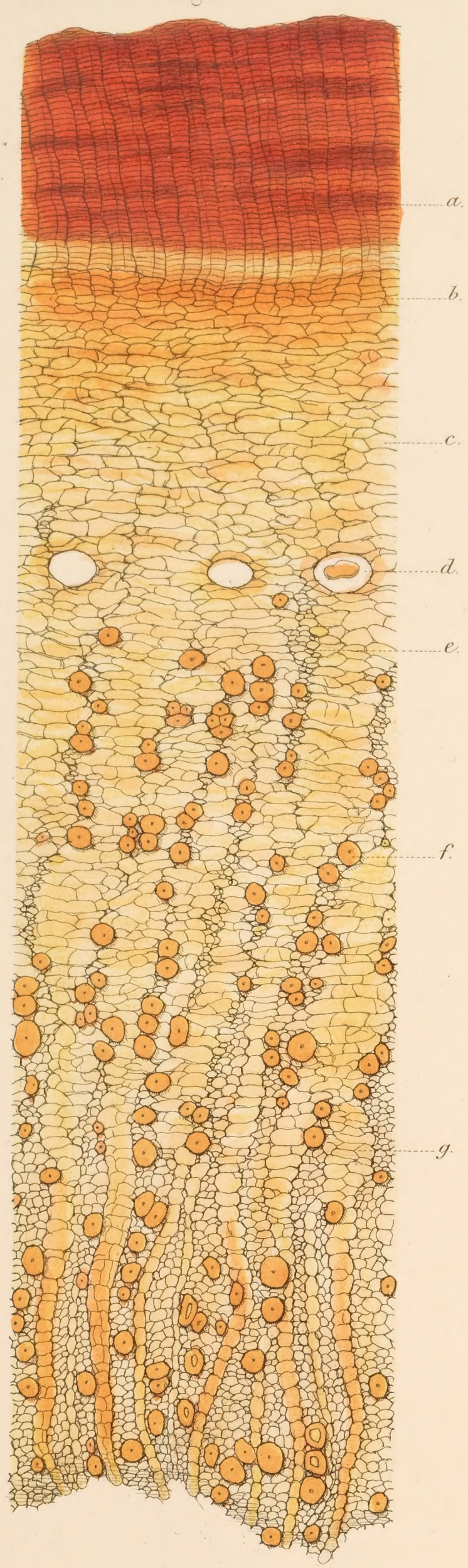


Fig: 13.

Red Bark of commerce.

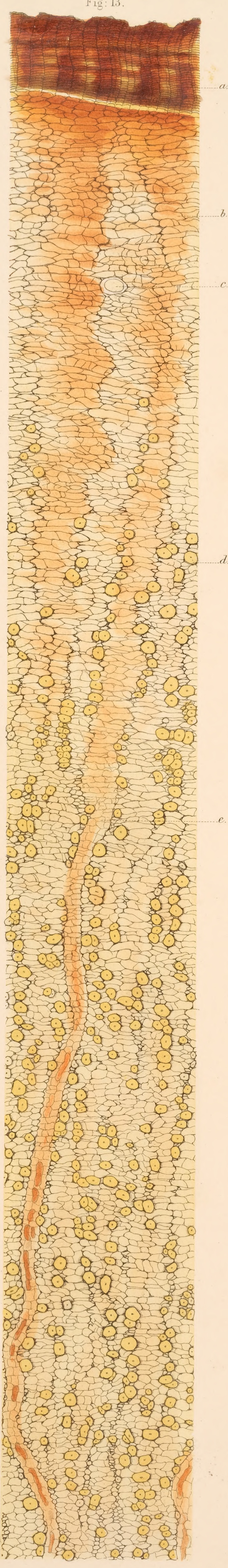


Fig: 14.

Cascarilla Pata de Gallina.

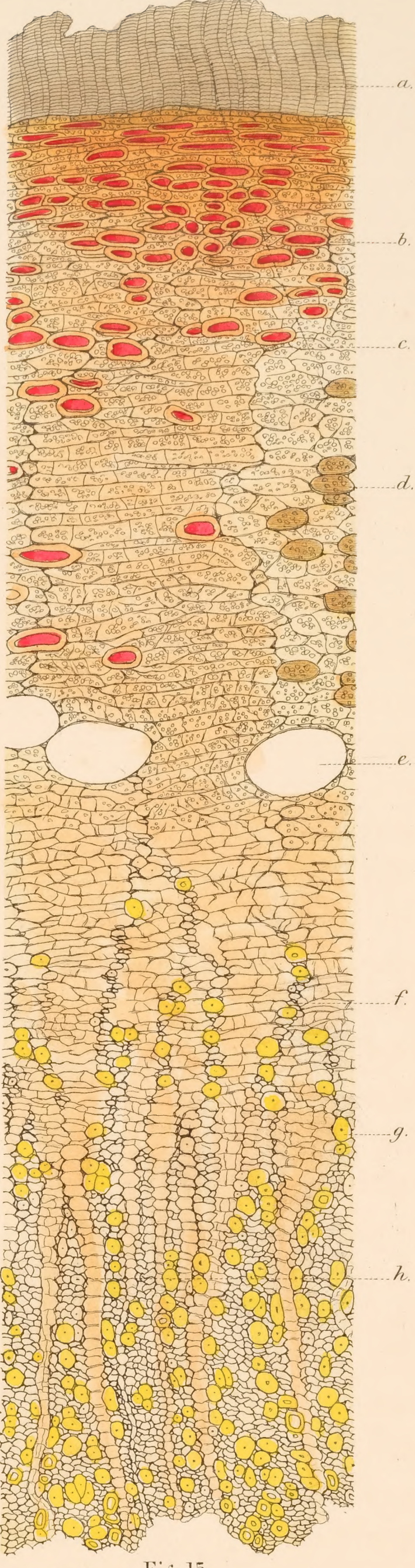


Fig: 16.

Cascarilla estoposa.

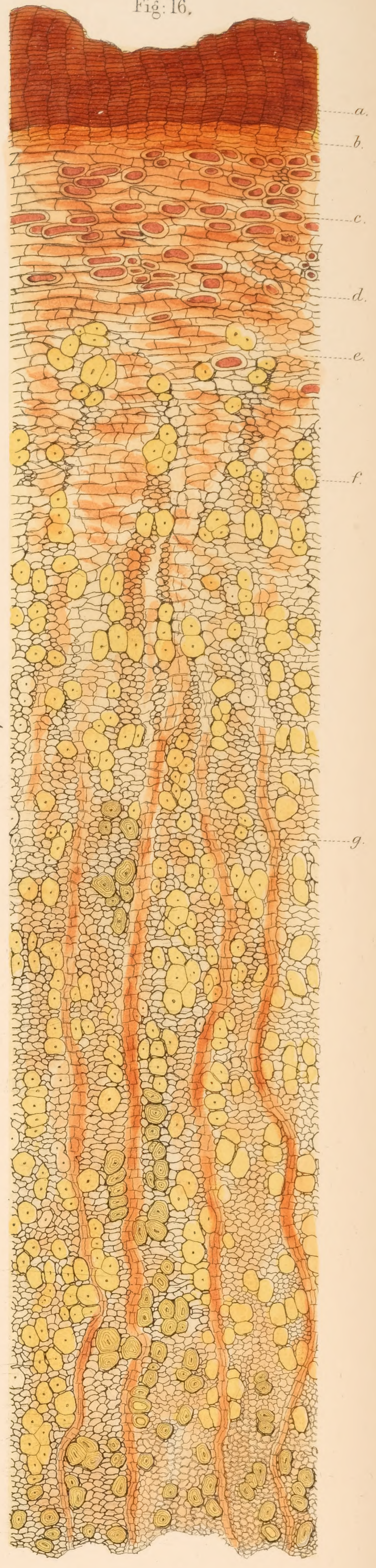


Fig: 12^a

Red Bark with Crystals of alkaloid.

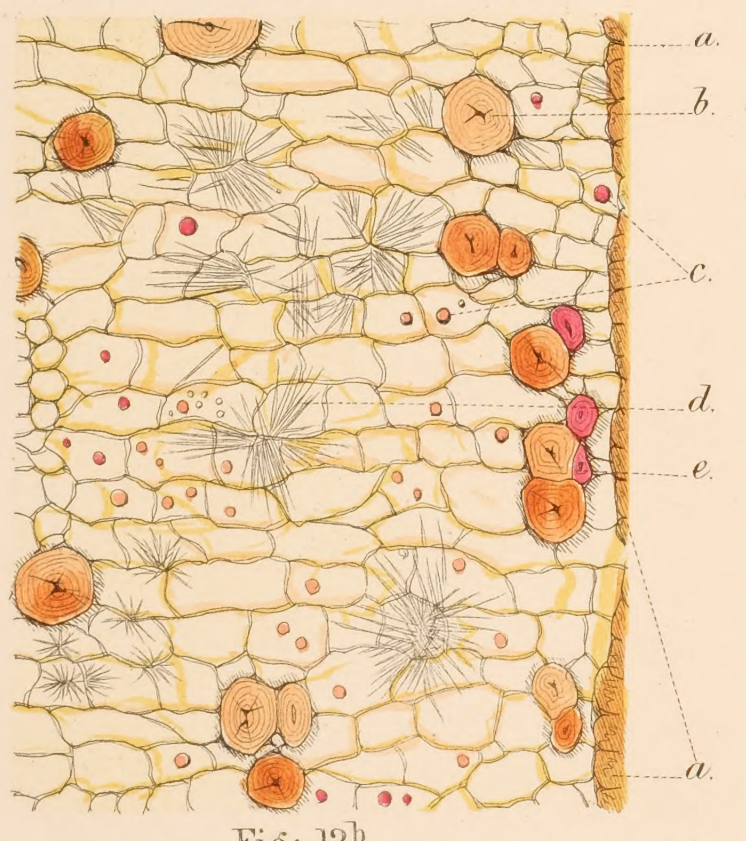


Fig: 12^b

Knives of quinine.

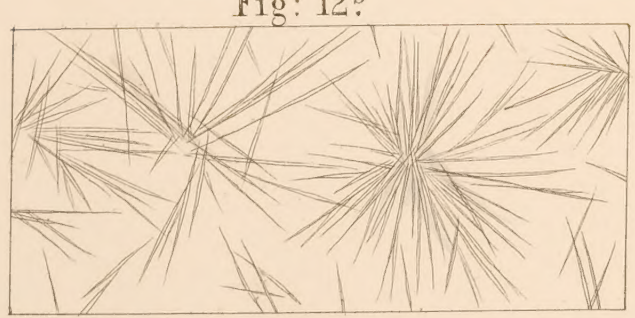


Fig: 13*

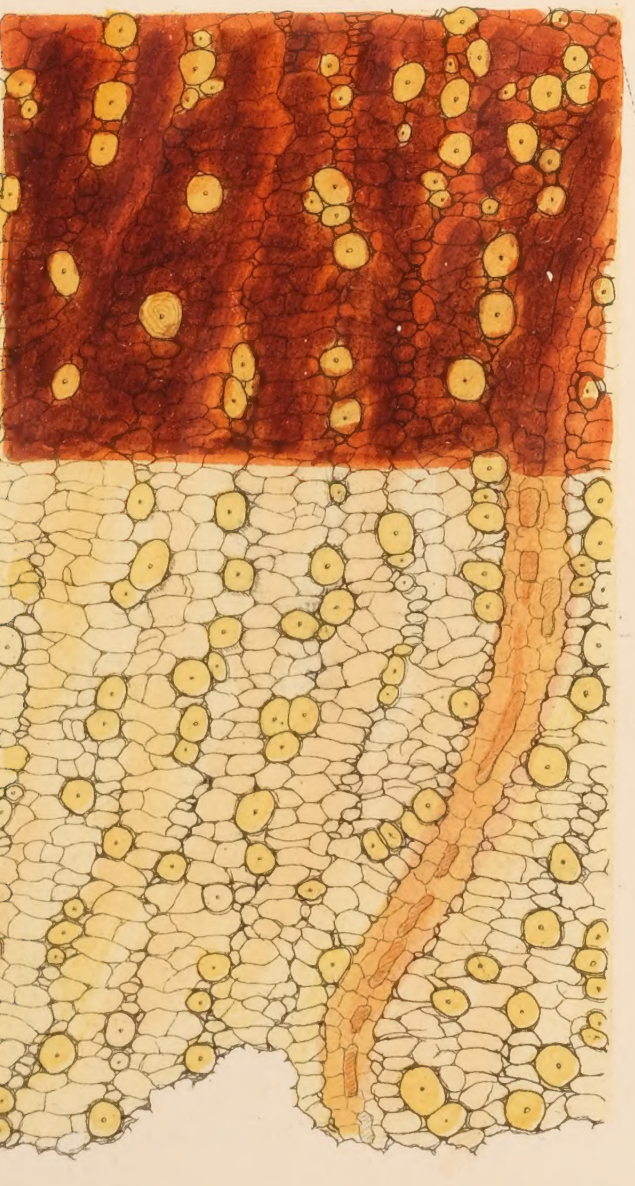


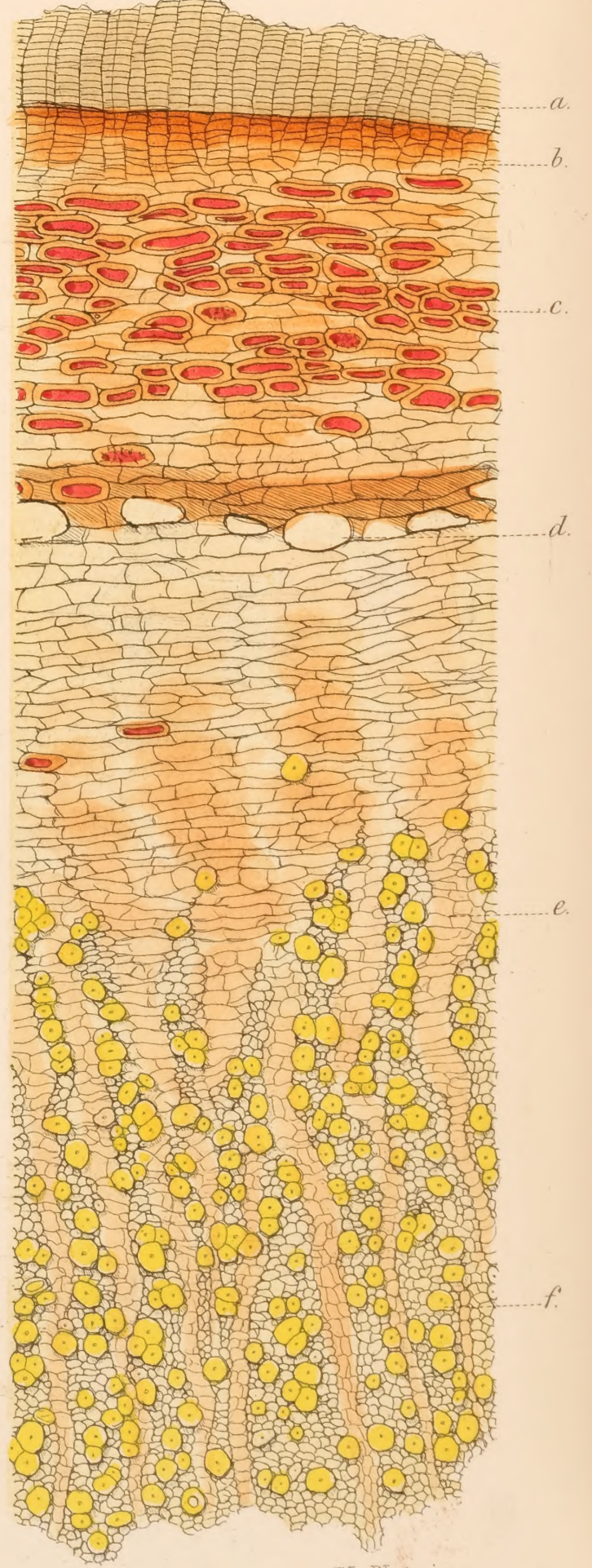
Fig: 15.

Cascarilla ahumada de Loja.



Fig: 17.

Quina d'Azahar.



not only to the chemist, but also to the importers of this article of merchandise; for it is not uncommon for the *cascailleros*, in collecting the bark of several species, to rasp or cut off the whole of the external portion, guided (no doubt rightly) by the taste of the suberous layers to reject them as worthless, but in doing this they frequently also sacrifice part of the cellular envelope. In order to ascertain the relative value of the outer and inner bark of the *Cinchona lancifolia* (which used to be treated in the above manner), I separated, in the year 1851, these two portions, and found in the Outer Coat,—Quinine, 1.18; Cinchonidine and Cinchonine, 1.02: total, 2.20 per cent. This portion contained the whole cellular envelope, with a portion of the liber. In the *Inner Bark*, consisting entirely of the liber, I found no Quinine, but Cinchonidine and Cinchonine 0.93 per cent. Of course no such separation effected by mechanical means could be perfect, but the inner portion can be relied on, as consisting exclusively of liber. It follows that in this case the cellular envelope was the seat of the Quinine, contrary to the hypothesis above named.

The Small Quills of this variety (containing much cellular envelope) gave on examination Quinine, 1.07; Cinchonidine and Cinchonine, 0.88: total, 1.95 per cent. The Middling Quills (about one quarter of an inch in diameter) gave Quinine, 1.00; Cinchonidine and Cinchonine, 0.90: total, 1.90 per cent. The Coarse, nearly Flat Pieces, from the trunk (more than half an inch in diameter), containing much liber-fibre, gave Quinine, 0.71; Cinchonidine and Cinchonine, 1.03: total, 1.74 per cent.; thus confirming the results of the preceding experiment.

Still further to investigate the relative contents of the cellular envelope and the liber, I recently took a remarkably fine piece of Red Bark, one-third of an inch thick, and about two feet long by six inches in width (bark of *C. succirubra*, of the sort called *China rubra dura* by the Germans), having a very decidedly developed (so-called) resinous ring, and capable of being separated by mechanical means into two portions equal by weight; one, the Outer Bark, comprising all the cellular envelope constituting the resinous ring, and also inevitably some of the liber; the other, consisting entirely of liber. The difference between these two portions was remarkable. The Outer Bark seemed to be in this case, as in the last, the chief seat of the Quinine, as well as of the greater part of the colouring matter and of the gum, and yielded me by far the largest percentage of alkaloids that I have yet found in any bark, viz., nearly eight and a half parts in a hundred. The Inner Bark, though rich in alkaloids to the extent of five parts in a hundred, did not contain nearly so much Quinine in a state capable of crystallization.

The produce of the Outer Bark, more exactly given in detail, was as follows:—Quinine (when in combination as salts, and crystallized, nearly five per cent.), = 3.65; Quinine not capable of crystallization, 2.66; and Cinchonidine, 1.34. These two portions, after solution in ether and in chloroform, were separated by solution in acetic acid, and decomposition by hydriodate of potash, which precipitates the Cinchonidine in a resinous form, whilst the other (left in the clear solution) was thrown down by ammonia as a resinous mass, incapable of crystallization in its subsequent combination with acids, though bearing much resemblance in its other properties to Quinine. Finally, I must add 0.83 of Cinchonine. The Hydriodate of Cinchonidine, on resolution in alcohol, let fall a very small flocculent precipitate, apparently of oxidized resin. The total product of the Outer Bark was thus 8.48 of alkaloids per cent. The same portion gave five per cent. of a bitter gum, but little kinate of lime, resin and kinovic acid in much the same proportion as the inner bark, in which latter the kinate of lime predominates.

In this Outer Bark the Quinine had been stored up more especially in the cellular envelope. It had been accompanied by an equally rich deposit of the Cinchona-red, a product of the Cinchotannic Acid, or mother-substance of the heart-wood (see *C. succirubra*, p. 22), which (as the bark reached my

hands) was more thoroughly oxidized in the Outer than in the Inner Bark. The very formation of the Quinine may have been assisted in some way by the coincident process of oxidation of the Cinchotannic Acid, the oxygen of the air being no doubt absorbed through the coats of the cells for this purpose. I must refer the reader to further observations on this subject under the head *C. succirubra*, pp. 14, 15, premising that the finest red pieces spoken of there are of a more spongy sort than the hard and more gummy kind now under consideration.

I could not obtain from the Inner Bark more than 5.28 per cent. of rough precipitated alkaloids, of which 2 per cent., insoluble in ether, appeared (by its subsequent crystallization as sulphate) to be Cinchonine; the remainder partly Quinidine (crystallizing as hydriodate), partly Cinchonidine, partly Quinine; but from this inner bark I was not able to obtain more than 0.77 of this last alkaloid crystallized in combination with an acid, and that with difficulty, though more might perhaps have been obtained if working on a larger scale. It is thus seen that the outer bark produced, as compared with the inner, between four and five times more Quinine in a form susceptible of crystallization when combined with acids, and on the whole more than fifty per cent. in excess of the inner, if we regard the total weight of the alkaloids.

We see in this an arrangement of the same nature as that which occasions in some barks the deposit of resin, in others those of starch in the region of the cellular envelope, probably stored there for the future wants of the plant. The above substances (resin and starch) will be seen as both abundantly present in the outer portion of No. 14, the section of *C. ovata*, a bark remarkably poor in alkaloids.

The large amount of alkaloid in the bark under examination, must not be taken as a standard of the ordinary produce of *C. succirubra*, which varies in this respect considerably. I do not find previously any record of a larger produce than 5.50 per cent., which is considerably below the average of Outer and Inner Bark, as above stated. In this case the Outer Bark contained alkaloids which, in combination with acids, may have amounted to between eleven and twelve per cent. of the weight of the bark. If Dr. Saunders had bark of quality resembling this to prescribe to his patients, it is not wonderful that he found remarkable effects produced, such as are mentioned under the head *C. succirubra*. It appears that the *C. succirubra* is not only the most beautiful tree in the forest, as stated by Mr. Spruce (in his recently published Report), but that it also bears away the palm from all other *Cinchonæ* in its power of producing alkaloids.

The Outer Bark, when reduced to powder, was of a more brick-red hue than the Inner, and eighteen parts out of a hundred were dissolved by boiling in water for an hour, whilst the Inner Bark lost only nine parts in a hundred by the same process. By digestion with solution of caustic, the outer lost seventy, and the inner portion forty parts in the hundred. The remainder of this last was very evidently composed chiefly of the liber-fibres; in the former there was a greater mixture of the remains of organized cellular structure.

As examined by my son, W. D. Howard, the ashes of the Outside Bark weighed 1.6 per centum; consisting of traces of silica, phosphates of alumina, iron, etc., 0.055; carbonate of lime, 0.535; magnesia, an appreciable quantity (more than the inner bark); manganese? the quantity of material not being sufficient for the definition of the last mentioned, nor for examination for potash or soda.

The Inside Bark left of ashes 1.4 per centum; containing traces of silica, phosphates of alumina, iron, etc., 0.03; carbonate of lime, 0.91; traces of magnesia, manganese?; the quantity being too small for examination for potash and soda.

The excess of lime found in the Inside Bark is no doubt the result of the preponderance of kinate of lime in the inner liber, a fact which other experiments demonstrated. Magnesia being

found in larger quantity in the Outside Bark, may probably be connected with the suberous envelope. The much greater solubility of the contents of the outer portion, notwithstanding the hard and dense structure of the "resinous circle," coincides with the result of analysis in demonstrating that resin (though not altogether absent) has little to do with the matter, and that it is the deposit of alkaloids together with mucilage and kinova-tannic acid, and a little wax, which really gives the character to this portion.

CRYSTALS OF ALKALOIDS IN THE BARK.

In order to gain as much information as possible from the rich bark under consideration, I made sections of a portion for microscopic investigation, and was rewarded by some appearances which I had not before seen. The general structure of the bark was fundamentally the same with fig. 13 and 13* (which indeed was from bark taken out of the same chest), but the eye was at once arrested by very numerous stellate groups of crystals, diffused irregularly throughout the substance of the bark. I thought at first that they must be *Raphides*; but further investigation led me to see that they are entirely soluble in spirit of wine, and even in ether, that they polarize the ray of light, and thus much more resemble combinations of the alkaloids than those bodies which are called *Raphides*, and which are understood to be composed of salts of lime and magnesia, insoluble in the media above named.

The crystals are arranged in the substance of the bark indeterminately and without any reference to the organic structure of the bark. They are not formed in the cells, but cross these in every direction; radiating generally from some small nucleus, and presenting very much the appearance of some compounds of the alkaloids in their crystalline form. They evidently are not the product of vital processes taking place in the plant in its living state, but must result from changes in the juices of the bark after its removal from the tree;* indeed, it can be no surprise if a sap-fluid containing eleven or twelve parts of salts of the alkaloids in a hundred should then at least (if not even whilst maturing on the tree) betake itself to crystallization.

In order to observe these perfectly, I found it necessary that the section of bark should not be too thin, as otherwise the action of the caustic would be too powerful, leaving only the ultimate structure of the cellular tissue, as in fig. 13. I compared the crystals with those of Cinchonine, Quinidine, and Cinchonidine; but the character of the decoction of the bark being always acid, seemed to forbid the expectation, which indeed was not realized, of finding the crystals coincide with these. At length it occurred to me to compare the crystallized compound of Quinine, formed, as I have mentioned under the head *C. succirubra*, by adding Quinine to the ethereal solution of the mother-substance from the heart-wood of the tree. I found the crystals, which under some circumstances this compound forms, to agree exceedingly well with those seen in the bark, and consequently engaged Mr. West to draw them for comparison, and they will be noticed at 12*b*. The feeble amount of polarization in the two was a point of coincidence that could not be passed over; and on the whole, it is almost certain that the Quinine is in this state of combination in Red Bark, since the decoction abandons, by cooling, a deposit in which I have ascertained the presence of Quinine, Cinchona-red, and Kinovic Acid, and after this has been deposited, no trace appears to exist of Kininate of Quinine, the only other probable form.

* Seven pounds of green give four pounds of dry bark in this species (*C. succirubra*), (Spruce, Report, etc., p. 28,) whilst the freshly-peeled bark of the *C. lancifolia* dries to one-third of its weight (Karsten, Medicinische Chinarinden, etc., p. 17), so much greater, in its growing state, is the density of the fluid constituents in the former kind of bark than in the latter.

I therefore conclude that the crystals seen in the Bark-section are *Kinovate of Quinine* rather than Kinova-tannate or Cincho-tannate, since the cinchotannic acid oxidizes off into Cinchona-red, and leaves the Quinine in combination with Kinovic acid, as an almost colourless salt, such as is seen in the section.

In the section of this particular piece I notice in the inner portion many of the fibres in the liber tinted with the red colour of the Cinchotannic Acid; also globules, rather abundant, of a colour almost blood-red, *apparently* from the same cause, whilst others are of a pale and translucent white. If a solution of isinglass be added to a pale-yellow decoction of the bark (after the red sediment has been deposited), and exposed to the air, the red coloration will be seen gradually extending itself in proportion to the access of the oxygen of the air, from the surface inwards, very much as it takes place in the bark. The addition of a few drops of ammonia completes the transformation immediately.

In order to ascertain whether there was anything peculiar in the piece under consideration, I have since made a section of a fine quill of Pavon's (mentioned under the head *C. succirubra*, p. 9), which appeared to be of similarly rich quality, and find similar crystals and coloured granules, also lozenge-shaped and cubical crystals, in abundance. These would probably be found in all Red Bark of like character, and refer apparently to the alkaloids in the bark.

EXPLANATION OF THE MICROSCOPIC SECTIONS.

The drawings were made, with strictest regard to the appearances of nature, by Tuffin West, F.L.S., whose skill in microscopical drawings is, I believe, unrivalled. They are all on the same scale, multiplied fifty diameters, with the exception of some figures which, in order to illustrate particular portions of the subject, are drawn under a different magnifying power, as noted beneath each figure.

In the *Cascarilla colorada del Rey* (No. 1) and the *Cascarilla amarilla del Rey* (No. 2), as also in the bark of *C. Uritusinga* (No. 20), we find a structure bearing considerable analogy to that of the *Calisaya*. The suberous layer is well developed in the *colorada*, less so in the *amarilla*, and in the *Uritusinga* the cells are exceptionally rounded. The cellular envelope is large, and in the two former shows traces of commencing medullary rays. The suberous layer in the *colorada* is densely packed with red-brown colouring matter, and the whole of the bark is pervaded with Cincho-tannic Acid, but in a different state (as indicated by chemical reagents) to that in which it exists in the *C. succirubra*.† The specimen of *amarilla* shows some laticiferous canals, which are not seen in the *colorada*. In the liber the medullary rays are numerous and closely packed; the liber-fibres are very few and small.

These barks yield Quinine, Cinchonidine, and Cinchonine. *C. succirubra* approximates in its structure to the above. The liber is however more largely developed, and the liber-fibres much more numerous, though small. The specimen of Pavon is remarkably contrasted with that from commerce as to relative thickness of the entire bark. It is interesting to observe a proportionate difference in the rate of development in plants now raised from seed at Kew. In each section condensed latex is seen in some of the laticiferous canals. The medullary rays are wavy and much twisted, and still contain a good deal of colouring matter, which has not been removed by the action of the caustic solution in which the specimens were boiled. The appearance of the bark without this treatment, and consequently gorged with oxidized products, is seen in the section 13*, which is otherwise a

† When a solution of gelatine is added to a settled decoction of the Colorado del Rey, it produces an immediate curdled precipitate of a fawn colour. A decoction of Red Bark, treated in like manner, produces only the effect mentioned in the last section.

Fig: 21.

Fig: 22.

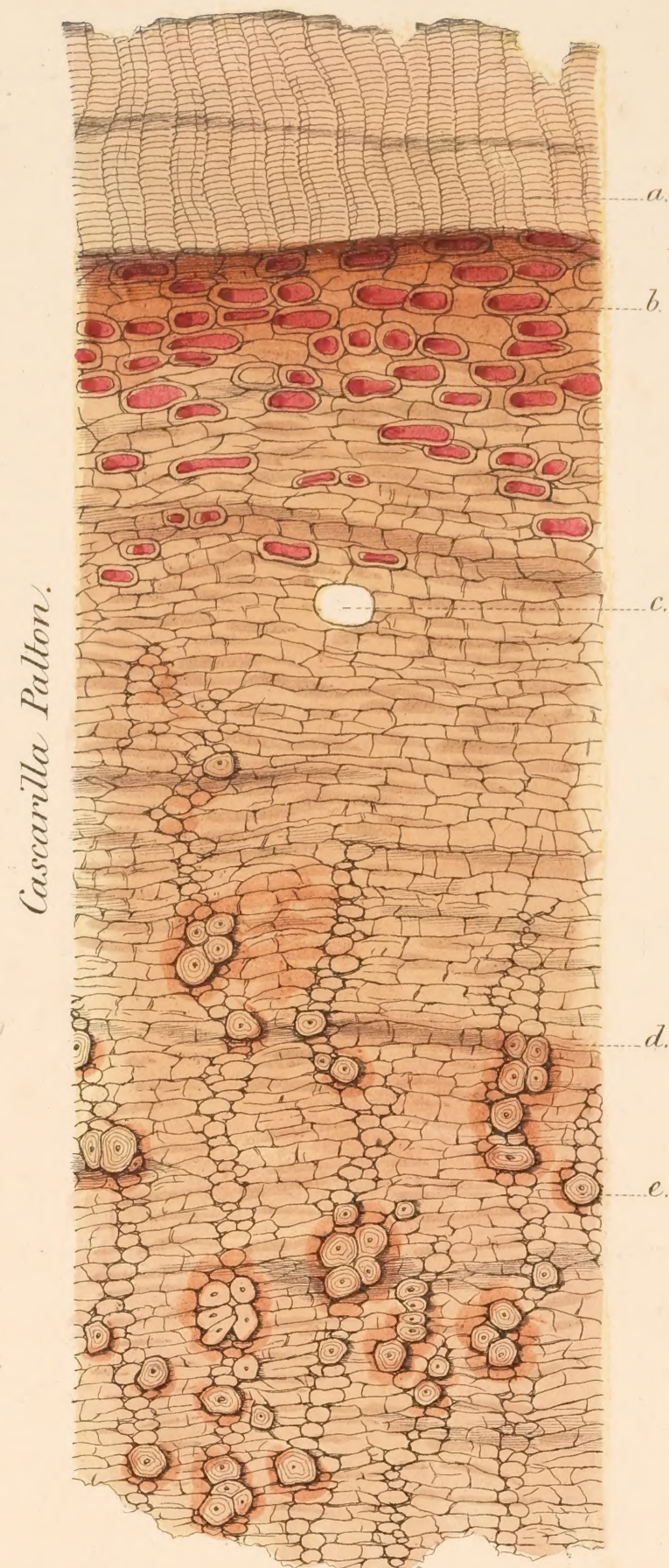
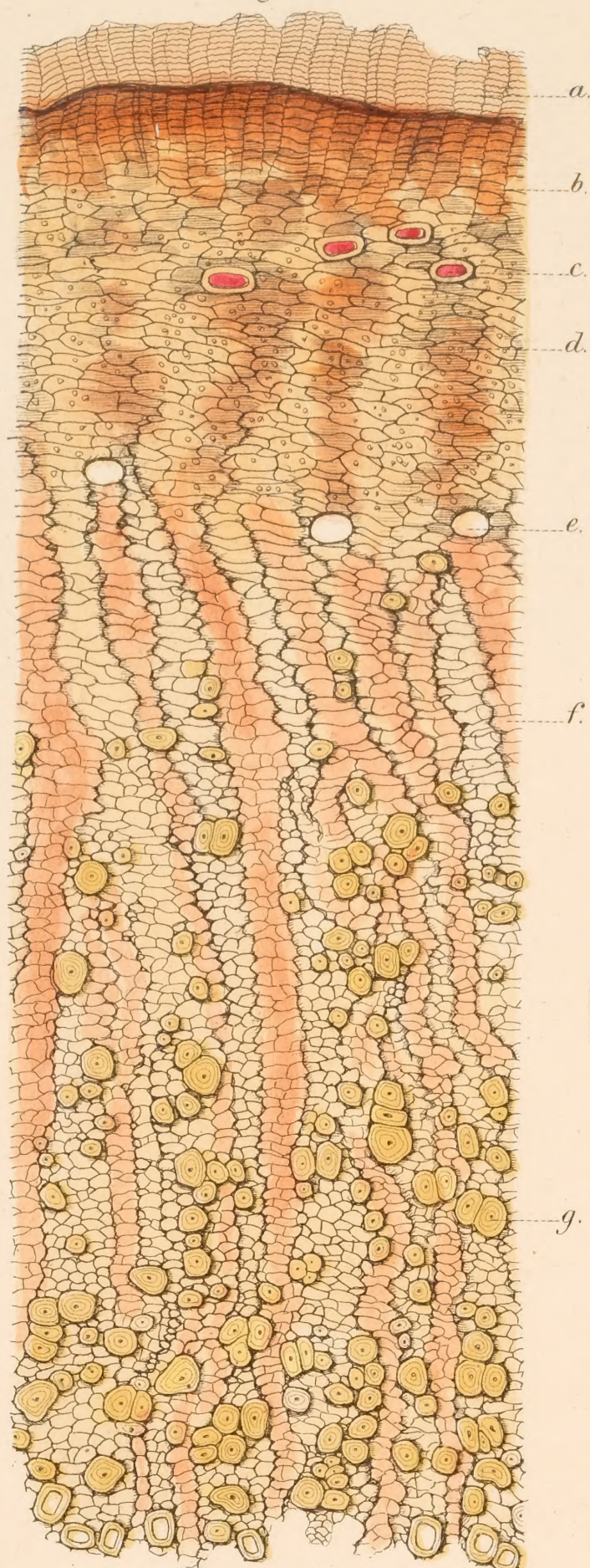
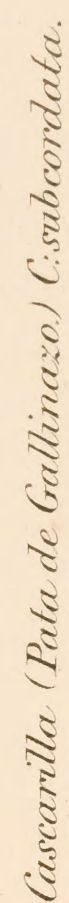


Fig: 23.

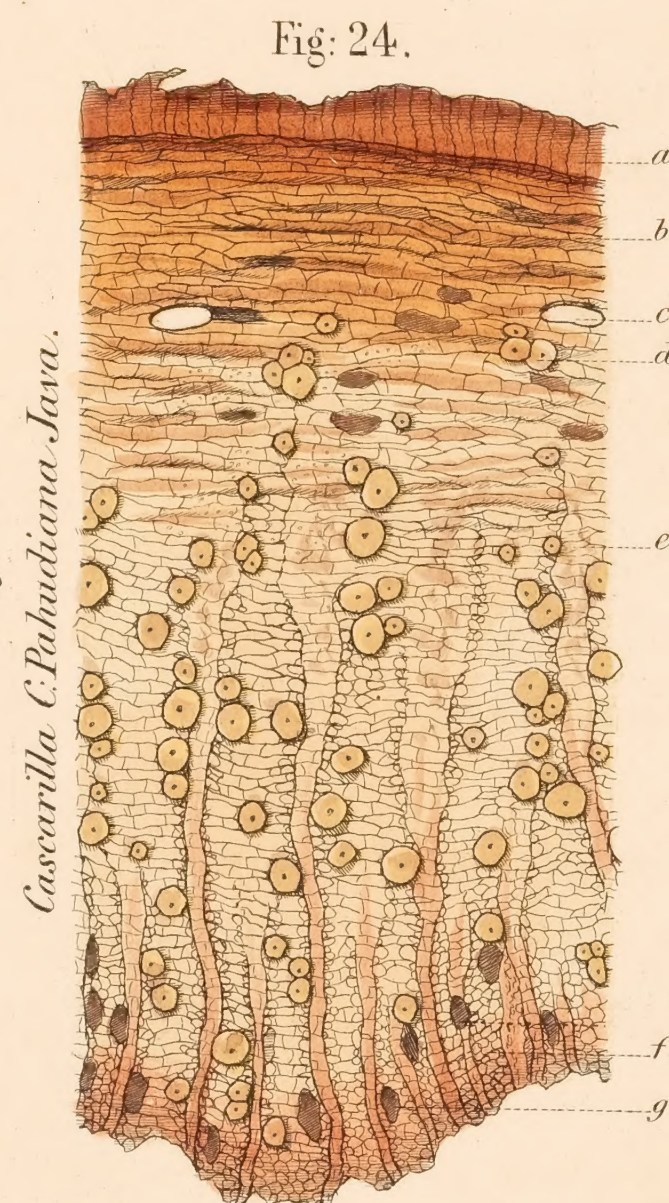
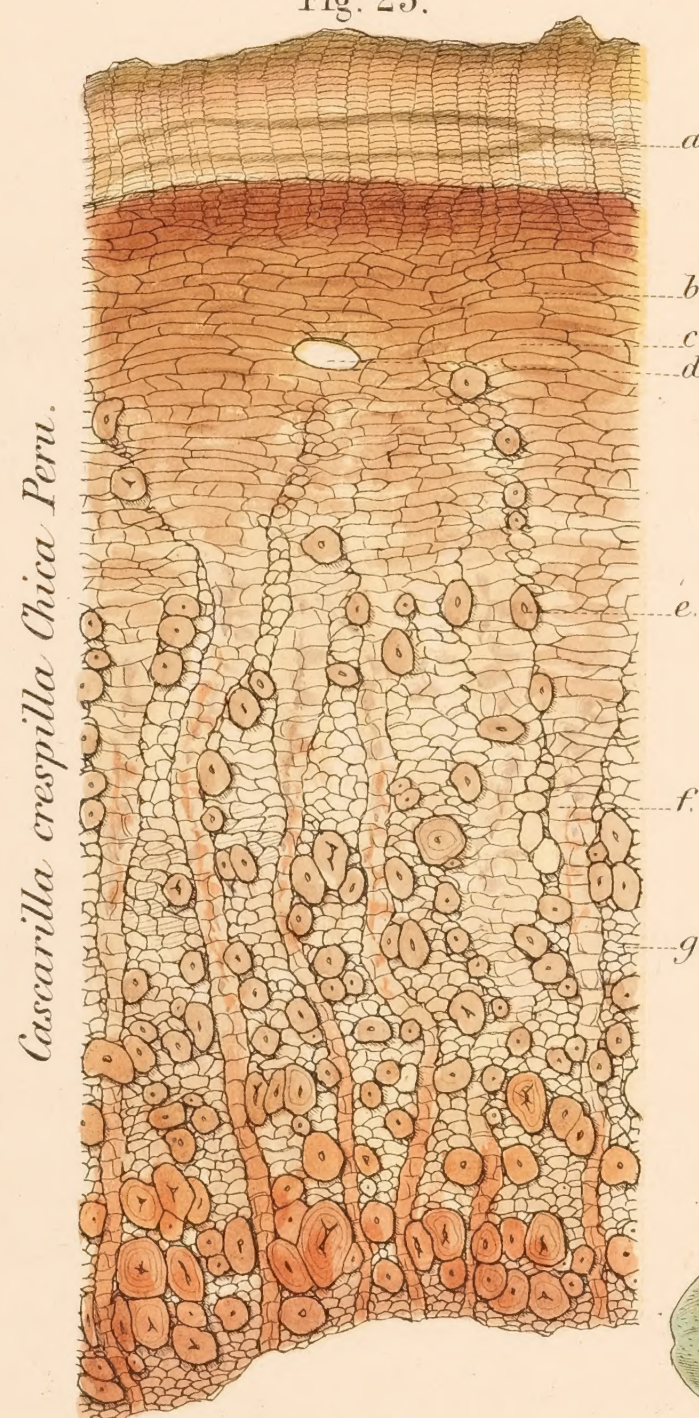
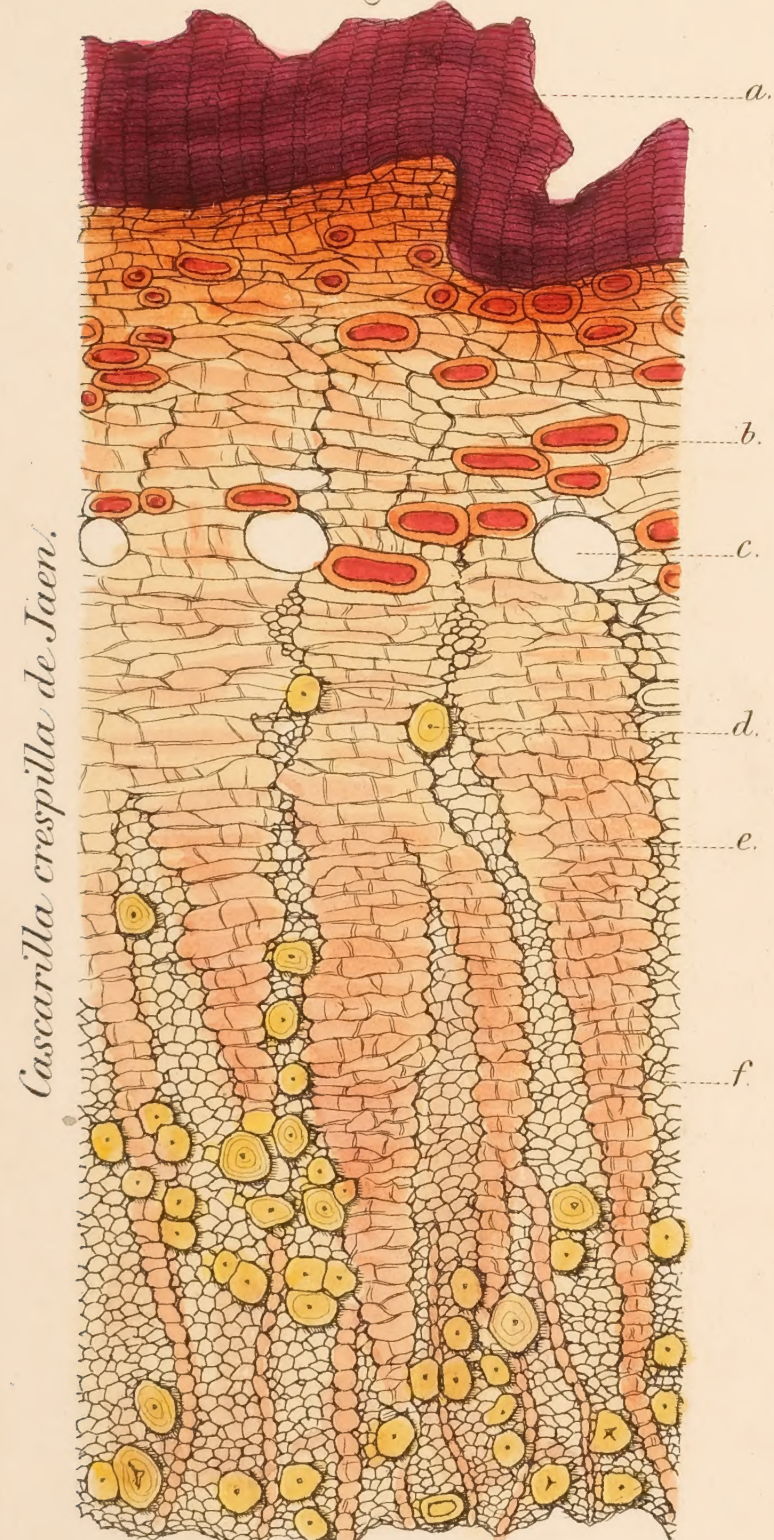
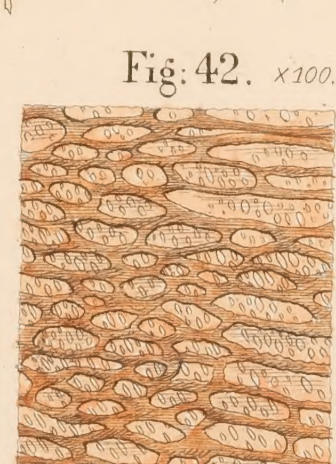
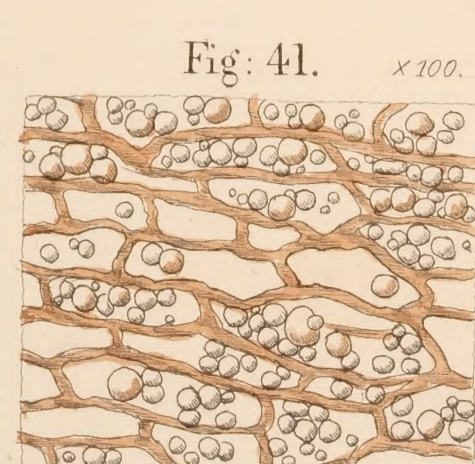
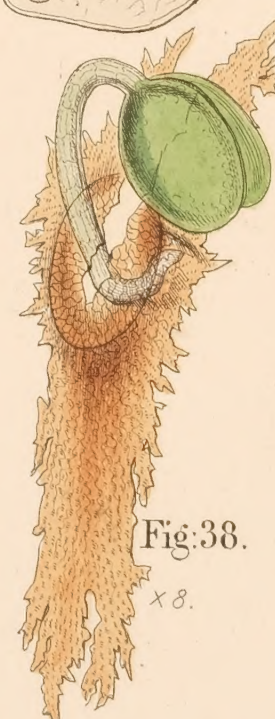
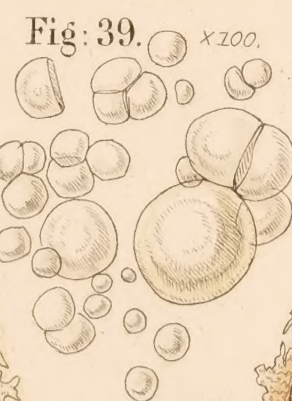
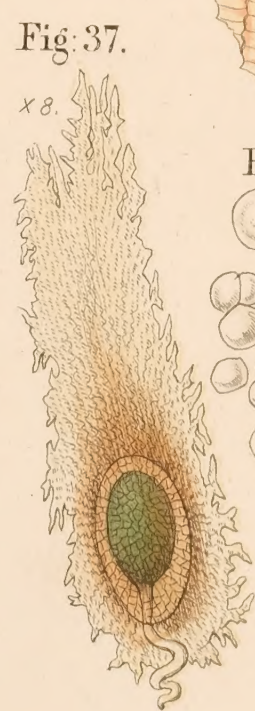
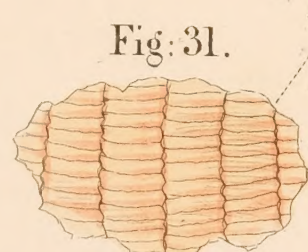


Fig: 20.



continuation of section 13, forming the complete drawing of the slice of thick Red Bark from commerce.

The bark of *Cinchona ovata*, like the plant itself, approximates to the *C. magnifolia*. Both have almost white suberous cells; many resin-cells scattered through the cellular envelope; laticiferous canals numerous and larger than in any other species seen; the medullary rays are much compressed by the numerous minute liber-fibres. There is much starch in both these barks, and very little Cinchotannic Acid in the *C. ovata*; whilst in the *C. magnifolia* this is entirely superseded by another colouring matter, the contrast of which is remarkably seen by comparison with the section (Fig. 13*) filled with oxidized colouring matter and other substances. In order to present this contrast fully to the eye, I have had the colouring of Fig. 17 introduced from a section which had not been subjected to the action of boiling caustic, so that both Fig. 13*, with its oxidized Cinchotannic Acid, and Fig. 17 and Fig. 26, with the colouring matter peculiar to the *Ladenbergia*, are seen in their natural state.

In *Cascarilla amarilla*, Fig. 9, the bark of *C. lutea*, and in *Cascarilla ahumada de Loja*, Fig. 15, the bark of *C. decurrentifolia*, we have the characteristic features of the class which I have described as *really* Yellow Barks; that is to say, proceeding from species of Cinchona in which the Cinchotannic Acid is superseded, in whole or in part, by a yellow resinous matter, of an intensely deep yellow colour in its normal state, but capable of becoming oxidized to a humus-like brown. It is in this state that it gives the peculiar colour to the section Fig. 15.

This colouring matter is specially associated with Aricine, which with Cinchonine is the general product of the *C. lutea* and its associated Yellow Barks, including the *C. Pelletierana* (the source from which aricine was first derived) and the kindred *C. pubescens*, the *C. villosa*, the *C. ovata*, the *C. microphylla*, *C. decurrentifolia*, *C. obovata*, and others. In all these barks the coarse large liber-fibres, often soldered together as described by Weddell, and often incomplete as illustrated in the small section No. 43, are most characteristic, and, together with the production of the peculiarly yellow colouring matter, indicate a near alliance with some of the allied genera.

I refer, as an illustration of this, to Winckler's chemical examination of the *China Jaen fusca*, from Rio Janeiro (the *Cascarilla Riedeliana* of Weddell?), in which he particularly notices the presence of an intensely yellow colouring matter, and from which he obtained an alkaloid named by him Paracine.

Winckler* notices the resemblance in chemical constituents of this Para bark to the *China Jaen pallida*, i.e. to the bark of *C. lutea*, and also the near alliance of Paracine with Aricine, he describes (that which is a striking peculiarity of the colouring matter) the greenish opalization of the solution by reflected light, also the peculiarly bitter taste of the alkaloid, and its general resemblance to Bebeerine, derived from the *Nectandra Rodiei*, a tree widely separated in its botanical characteristics. All these particulars I can confirm from my own examination of this same "Pará Bark," coinciding in all respects with a sample in my possession from Winckler, and from comparison with the analysis of the barks of *C. Pelletierana* and *Nectandra Rodiei*. The microscopic examination of this bark from Pará discloses a particularly cinchonaceous structure, so that both as regards the cellular structure and the chemical analyses of the barks, we have the evidence of an intimate relation between these Yellow Barks and at least one analogous bark in an allied family.

Another South American bark allied to the *Cinchonæ* also furnished me with a remarkably abundant yellow colouring matter, associated with an alkaloid, as described by Dr. Weddell under the head *Howardia febrifuga*, in the article on the *Rubiaceæ* of tropical America, in the 'Annales des Sciences Naturelles' for 1854.

I now come to another class, the Cinchonine-producing "Grey Barks." The section of *Casca-*

* In Buchner's 'Repertorium' for 1846, p. 30.

rilla Reicheliana, from *Cinchona Reicheliana* (No. 4), marks this bark as very distinct from the other sorts of Grey Bark. It has no resin-cells, and small and inconspicuous laticiferous ducts. The suberous layer contains much colouring matter, indistinctly marked out from the cellular envelope, part of which seems to be in a state of transition into cork; the medullary rays are large, but not so distinctly marked out as in the *C. nitida*. The liber-fibres are very densely packed towards the cambium, and are rather large and strong. There are very fine starch-grains throughout this specimen, most numerous in the cellular envelope.

Cascarilla Provinciana (No. 3), the bark of *C. micrantha*, has some resin-cells near the epidermis, which shows a few fragmentary cells of corky structure. The laticiferous canals are remarkably numerous, as also the liber-fibres, which are closely packed, and compress excessively the medullary rays, making them almost opaque.

Quina cana legitima (No. 5), from *C. nitida*, has (in this specimen of Pavon's) lost the suberous layer almost entirely. It is abundantly provided with resin-cells, some placed longitudinally, and some assuming the appearance which might lead to their being regarded as crystal-cells, but which, on careful examination with a higher power, prove to be cells with thickened walls, in which are numerous minute ducts, which can be made out (by focussing) to penetrate the substance of the cell-wall much in the same manner in which this is seen in animal bones. Some of these cells may be seen in our fig. 40. The liber-fibres are scattered through the substance of the internal bark much as in the *Calisaya*; but in this case the structure would be erroneously supposed to indicate a rich production of Quinine, which is not found in this specimen; but in most of these Grey Barks* Cinchonine is the abundant product, associated with some alkaloid resembling Aricine or Paracin, whilst in the *Cascarilla Pata de Gallinazo* (No. 7), from *C. Peruviana*, the chief product is the Cinchonidin of Wittstein. In this specimen (from Pritchett) the suberous layer remains, and is abundant; the resin-cells and laticiferous vessels less marked than in the *C. nitida*. Many of the liber-fibres are incompletely filled up, but otherwise the general structure of the liber has much analogy with that of the Red Bark of commerce, but perhaps still more with *Cascarilla estoposa* (No. 16). The latter bark however does not show any laticiferous vessels, and is much more fibrous in its structure, partly the result of the peculiarly definite and straight medullary rays, which, no doubt, facilitate the separation of the bark in the direction of the course which they pursue.

Cascarilla hoja de Lugma, from *C. lucumæfolia*, No. 8, is very nearly related, botanically and chemically, to the last-mentioned, but, microscopically investigated, the liber is seen to form more than half the thickness of the bark, the liber-fibres to be much larger, and trenching remarkably upon the medullary rays; the inner portion of the liber, towards the cambium, very pale and transparent, but the liber-fibres in this part are of a red-brown colour; the resin-cells are also mixed up to an unusual degree with the liber; the result is a much harder and more woody bark than the preceding.

The following are indeterminate as to association:—

Cascarilla con hojas de Roble, No. 18, reminds of the *Cascarilla estoposa*. It has the suberous layer thick, pale, transparent-brown inwardly, outwardly very dark-brown. The resin-cells are moderately numerous, small and scattered. The medullary rays are very numerous, straight, and fine, leading to a finely fibrous division of the bark, similar to the *Cascarilla estoposa*. The liber-fibres are small, conglomerate, encroaching on the cellular envelope.

Cascarilla (Pata de Gallinazo Esp. 2^a, Pavon), No. 21, from *C. subcordata* (the "Ash Bark" of Pereira), has a remarkably undefined pale-coloured suberous coat, verging by degrees into the cellular envelope, and occasioning, no doubt by its partial exfoliation, the peculiar character of coat described

* I have not examined the *C. Reicheliana*.

by Pereira (from whom I possess samples in accordance with these of Pavon). The resin-cells are few and small. There is much starch in the cellular envelope, especially in the cells which are near the termination of the medullary rays. These are numerous, and much interrupted by the liber-fibres. The cellular envelope is partially very thick-walled, as shown in No. 42.

Cascarilla crespilla de Jaen (No. 19), from *C. umbellulifera*, is a remarkable, but not very promising bark, having the suberous layer thick and much corrugated. The resin-cells are numerous, and not unfrequently with their long axes perpendicular. The laticiferous canals are numerous and rather large; the medullary rays very large towards their outer portions, and much twisted about by the numerous liber-fibres, some of which show an imperfect state of development.

The *Cascarilla crespilla Chica* (No. 23), from Peru, is a bark not altogether unpromising at its first aspect. It is a rather thin bark, and yet of a more robust structure than the specimen from Java, the tender structure of the cellular tissue of which I have noticed under the head *C. Pahudiana*. The suberous layer in the present bark is pale-brown, stratified and better developed, and the liber-fibres much more so than in the sickly Java tree. Some of these, near the cambium, are large, clustered, red-coloured, and approach the *C. pubescens* type. The cellular envelope bears a very small proportion to the bark. These last are unfavourable indications. The laticiferous canals are small, and not numerous.

The same bark, *C. Pahudiana* (No. 24), from Java, shows the same general features, but (as I have mentioned in the description) the tree had suffered from the attacks of *Dermestes*, and the bark is evidently unhealthy; the cambium development appears to be arrested, and abnormal deposits make their appearance in every part.

Cascarilla Palton (No. 22) has the suberous layer thick, pale-coloured; the resin-cells form a dense stratum outwardly, imparting the peculiar orange-red aspect to the derm, which is characteristic of the bark; the cellular envelope is much stratified, and intersected by laticiferous ducts; the medullary rays very indistinct; the liber-fibres not numerous. The product of this bark is Cinchonidine, but it also produces Quinine, though in small proportion.

Cascarilla negrilla (No. 25), from *C. heterophylla*, has a thick suberous layer, very black when seen on the tree, unless interrupted by the silvery-white thallus of adherent *Parmeliaceæ*, etc. The contrast in the section between the clear brown of the cellular envelope and the nearly colourless and transparent liber, is very striking. There is much colouring matter, probably Cinchotannic Acid, with starch, in the cellular envelope. The medullary rays are thin; the whole liber is extremely transparent. The liber-fibres are few, small, imperfect, near the cambium. Laticiferous canals are present, but very small and few in number. This bark produces chiefly Quinidine of Pasteur, united to much Cinchotannic Acid.

The *Cascarilla amarilla de Chito* (No. 10), though attributed by Pavon to the *C. lutea*, stands, by its microscopic constitution, much nearer to the *C. cordifolia* of Mutis, and, as I have mentioned under the head *C. lutea*, occupies perhaps an intermediate place. The suberous envelope detaches itself easily from the highly vascular cellular envelope, verging, with intervention of some small laticiferous ducts, into an equally vascular liber, permeated by large medullary rays, and interspersed with a few small scattered liber-fibres. I have not found this sort in commerce, but, from its close analogy with the *C. cordifolia*, conclude that it is equally poor in therapeutic products, notwithstanding the abundance of parenchymatous tissue might lead to a different conclusion.

The remaining sections show the contrast between the true *Cinchonæ* and the allied *Ladenbergiæ*, a contrast to my mind less striking in the fundamental structure than in the colouring and chemical character of the not yet organized cell-contents of the bark.

In *Cascarilla Flor d'Azahar* (No. 17), from *C. magnifolia*, we find the suberous layer pale-coloured, the resin-cells very numerous, forming layers, and outwardly closely packed. The contents are no doubt the peculiar colouring matter of this bark, and not any resinous matter. The medullary rays are attenuate, crushed by the very numerous minute liber-fibres. The laticiferous vessels assume that large and permanent development which strongly, but not universally, characterizes these barks.

Quina roja de Mutis (No. 26) (section of a specimen brought as such by Humboldt, and very characteristic of the sort which I have described as *Quina nova*, under the head *C. magnifolia*). This was given me by Klotzsch, and is deficient in the laticiferous vessels, in other respects symbolizing well with the *Flor d'Azahar* of Pavon, from which it differs more in external appearance than in microscopical characteristics. It agrees in these with the *Quina nova Xauxa* of Pavon, and in all probability is derived from the *C. Bogotensis* of Karsten.

In No. 34, 35 are seen some of the earliest forms of development of the seed of *C. nitida*, which I had the opportunity of observing, and drew under the microscope from seed brought by Mr. Pritchett and vegetating under my care. In No. 34 the cotyledons are still enclosed in the testa, but the descending axis has probably forced its way through the integuments of the seed, and simultaneously an elbow-like projection of the ascending axis makes its appearance, destined in time to rupture and escape from the testa, as appears more distinctly in 35 and 38, and in the end to bear the cotyledons expanded on its summit, as is seen in fig. 36. In 35 the descending axis is seen, which really passes through the envelope near the centre of the seed, but whilst observed in water could not fail to diverge a little from this. Every part of this radicle is white and pellucid, but every part of the ascending axis is coloured green, by the chlorophyll it contains. The radicle bears a number of almost transparent fibres, which adhere, probably by their spongioles, so strongly to the small pieces of silica, etc., forming the soil in which the seeds vegetate, that it was not easy to separate them. Nos. 37 and 38 are germinating seeds of the *C. micrantha*, drawn by Mr. West. No. 36 shows very well the young plant of *C. nitida*, several of which in my possession are now developing much more rapidly than was the case with *C. succirubra*, and have attained a height of twelve inches. The difference is very manifest between this species and *C. Peruviana*, which has not only a different habit, but also appears to be a more delicate plant, and one difficult to rear; nevertheless I have some alive even of this last.

SECTIONS OF BARK.

PLATE I.

Fig. 1. *Cascarilla colorada del Rey*.—*a*, the suberous coat, consisting of oblong cells; *b*, cells apparently undergoing change into cork; *c*, cellular envelope, with commencing rudimentary medullary rays; *d*, medullary rays, in a fully formed state; *e*, scattered fibres of the liber.

Fig. 2. *Cascarilla amarilla del Rey*.—*a*, the suberous coat; *b*, undergoing change; *c*, cellular envelope, with medullary rays; *d*, laticiferous vessels; *e*, liber, intersected by medullary rays.

Fig. 3. *Huanuco Bark* (from *C. micrantha*), Pæppig's specimen.—*a*, resin-cells; *b*, cellular envelope, with commencing medullary rays; *c*, laticiferous vessels; *d*, liber-fibres; *e*, compressed medullary rays; *f*, imperfect liber-fibres.

Fig. 4. *Cascarilla Reicheliana* (Pæppig's specimen, *varietas alpestris*).—*a*, suberous coat; *b*, cellular envelope; *c*, thick-walled laticiferous vessels; *d*, liber-fibres.

Fig. 5. *Quina cana legitima* (from *C. nitida*), Pavon's specimen.—*a*, suberous envelope; *b*, resin-cells (some placed longitudinally); *c*, cells with thick walls, and these furnished with pores; *d*, laticiferous vessels; *e*, liber, intersected by medullary rays, and with resin-cells interspersed.

Fig. 6. *Cascarilla con hojas redondas* (from *C. macrocalyx*), Pavon's specimen.—*a*, suberous envelope; *b*, resin-cells; *c*, liber-cells, commencing; *d*, the same, much agglomerated; *e*, in an immature condition.

Fig. 7. *Cascarilla Pata de Gallinazo* (from *C. Peruviana*), Pritchett's specimen.—*a*, suberous coat; *b*, changing into cork; *c*, laticiferous vessels; *d*, resin-cells; *e*, very small cells, interposed between the medullary rays; *f*, liber-fibres; *g*, liber-fibres, not completely filled up with secondary deposit.

Fig. 8. *Cascarilla con hojas de Lugma* (from *C. lucumæfolia*), Pavon's specimen.—*a*, suberous coat; *b*, changing into cork; *c*, thick-walled resin-cells; *d*, crystal cells? *e*, liber-cells; *f*, medullary rays.

Fig. 9. *Cascarilla amarilla de Ynta* (from *C. lutea*), Pavon's specimen.—*a*, remains of suberous coat; *b*, thick-walled cellular envelope; *c*, large laticiferous duct; *d*, large liber-fibres; *e*, the same, incomplete; *f*, medullary rays; *g*, parenchyma of the liber.

Fig. 10. *Cascarilla amarilla de Chito* (from *C. lutea*), Pavon's specimen.—*a*, remains of suberous coat; *b*, cellular envelope, with commencing medullary rays; *c*, laticiferous canals; *d*, liber-fibres; *e*, medullary rays.

PLATE II.

Fig. 11. *Cascarilla colorada de Huaranda* (*C. succirubra*), Pavon's specimen.—*a*, suberous coat; *b*, changing; *c*, cellular envelope; *d*, laticiferous ducts, with latex remaining; *e*, small interposed cells of parenchyma; *f*, liber-fibres; *g*, medullary rays.

Fig. 12 *a*. Red Bark, with crystals of alkaloid.—*a*, medullary ray; *b*, liber-fibre; *c*, starch granules; *d*, crystals of Kinovate of Quinine; *e*, smaller liber-fibres, coloured by cincho-tannic acid.

Fig. 12 *b*. Crystals of Kinovate of Quinine on glass.

Fig. 13. Red Bark of commerce (from *C. succirubra*), specimen found in commerce. 13 and 13* unitedly represent the section of a fine piece of Red Bark.—*a*, suberous coat; *b*, cellular envelope; *c*, laticiferous vessel, still containing latex; *d*, liber-fibres; *e*, medullary rays.

Fig. 14. *Cascarilla Pata de Gallereta* (from *C. ovata*), Pavon's specimen.—*a*, suberous envelope; *b*, resin-cells; *c*, cellular envelope, with starch; *d*, cells, filled with starch and resin; *e*, laticiferous ducts; *f*, small cells, interposed between the medullary rays; *g*, liber-fibre; *h*, medullary rays.

Fig. 15. *Cascarilla ahumada de Loja* (from *C. decurrentifolia*), Pavon's specimen.—*a*, suberous coat; *b*, cellular envelope, with starch and colouring-matter; *c*, large imperfect liber-fibres; *d*, medullary rays.

Fig. 16. *Cascarilla estoposa* (from *C. stupea*), Pavon's specimen.—*a*, suberous coat; *b*, changing; *c*, resin-cells; *d*, crystal-cell; *e*, cellular envelope; *f*, liber-fibres; *g*, medullary rays.

Fig. 17. *Quina d'Azahar* (from *C. magnifolia*), Pavon's specimen.—*a*, suberous envelope; *b*, changing; *c*, resin-cells; *d*, laticiferous ducts; *e*, medullary rays; *f*, liber-cells.

PLATE III.

Fig. 18. *Cascarilla con hojas de Roble* (from *C. microphylla*), Pavon's specimen.—*a*, suberous envelope; *b*, resin-cells; *c*, cellular envelope; *d*, liber-fibres; *e*, medullary rays, with resin or tannin; *f*, compressed cells of the medullary ray.

Fig. 19. *Crespilla de Jaen* (from *C. umbellulifera*), Pavon's specimen.—*a*, suberous coat; *b*, resin-cells; *c*, laticiferous ducts; *d*, liber-fibres; *e*, medullary ray; *f*, small parenchymatous cells of the liber.

Fig. 20. *Quina fina de Uritusinga* (from *C. Uritu-*

SECTIONS OF BARK.

singa), specimen from Riofrio.—*a*, polygonal or rounded cells of the suberous coat; *b*, cellular envelope; *cc*, double rows of laticiferous ducts; *d*, small cells of the liber; *e*, liber-fibre.

Fig. 21. *Cascarilla* (*Pata de Gallinazo*, 2^a Esp.), Pavon's specimen, from *C. subcordata*.—*a*, suberous coat; *b*, changing; *c*, resin-cells; *d*, thick-walled cellular envelope; *e*, laticiferous ducts; *f*, medullary rays; *g*, liber-fibre.

Fig. 22. *Cascarilla Palton* (from *C. Palton*), Pavon's specimen.—*a*, suberous coat; *b*, resin-cells; *c*, laticiferous duct; *d*, commencing medullary rays; *e*, liber-fibres.

Fig. 23. Java Bark (from *C. Pahudiana*), specimen from Hasskarl.—*a*, suberous coat; *b*, changing; *c*, cellular envelope; *d*, laticiferous duct; *e*, liber-fibres; *f*, medullary rays; *g*, small cells of the liber.

Fig. 24. *Cascarilla crespilla Chica* (from *C. Pahudiana*), specimen from de Vrij.—*a*, suberous coat; *b*, cellular envelope; *c*, laticiferous ducts; *d*, liber-fibres; *e*, medullary ray; *f*, small parenchymatous cells of the liber; *g*, abnormal deposits.

Fig. 25. *Cascarilla crespilla negra* (from *C. heterophylla*), Pavon's specimen.—*a*, suberous coat; *b*, cellular envelope; *c*, laticiferous ducts; *d*, liber-fibres; *e*, small cells of the liber; *f*, medullary rays.

Fig. 26. *Quina roja* of Mutis (from *C. Bogotensis*), Humboldt's specimen.—*a*, suberous layer; *b*, cellular envelope; *c*, resin-cells; *d*, liber-fibres; *e*, small cells of the liber.

Fig. 27. Seed of *Cinchona nitida*, magnified 12 diameters.

Fig. 28. "Represents a transverse section of the Testa near the centre, and shows the three coats of which it is composed."

Fig. 29. "The Outer Coat is formed of thick-walled sinuous cells, strengthened by coarse reticular fibres. These cells are especially sinuous on the alæ."

Fig. 30. Central do. "At the centre the cells tend to

assume a long quadrate form, and frequently send up hook-shaped processes from different parts of their walls. These are well seen in the transverse section (fig. 28)."

Fig. 31. Second do. "The Middle Coat is formed of narrow hexagonal cells, much resembling a pavement, the lines formed by the junction of the narrow-pointed interlocking ends of the hexagon running parallel with the long diameter of the seed."

Fig. 32. Third do. "The Third Coat consists of a pale-coloured, very transparent tissue of hexagonal cells, arranged without any regularity."

Fig. 33. Lateral margin. "The line of cells forming the margin of the seed-wing is papillate, the *papillæ* projecting outwards in a very singular manner, and in some species very irregularly. The cells have a slight and imperfect network of deposit upon them."—*Notes by Mr. Tuffin West*. (All these are magnified 75 diameters.)

Fig. 34. Development of *C. nitida*, magnified 8 diameters.

Fig. 35. Do. of *C. nitida*, magnified 8 diameters.

Fig. 36. Do. of *C. nitida*, magnified 8 diameters.

Fig. 37. Development of *C. micrantha*, magnified 8 diameters.

Fig. 38. Do. do., magnified 8 diameters.

Fig. 39. Starch, free, from *C. ovata*, magnified 100 diameters.

Fig. 40. Starch, obscured by resin and thick-walled porous cells, from *C. subcordata*, magnified 100 diameters.

Fig. 41. Starch, with little resin, *C. ovata*, magnified 100 diameters.

Fig. 42. Thick-walled cells, magnified 100 diameters.

Fig. 43. Liber-fibres, trans. *C. decurrentifolia*, magnified 100 diameters.

Fig. 44. Laticiferous ducts (with latex) and parenchyma of Red Bark, magnified 100 diameters.

